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EXPERIMENTAL COCONUT CULTIVATION IN CEYLON.

Elsewhere we publish the yields of the Chilaw Coconut Trial ground for 1915 and the first quarter of 1916. The figures for 1915 show that the trees differ considerably in productiveness, due to inequalities in soil fertility of the various plots. For this reason it will be necessary in future to estimate the value of the treatments applied not by absolute results but by proportionate increases or decreases taking each plot as its own control. We find this system more satisfactory in the case of other products as well because absolute uniformity of soil can never be obtained except with pot culture. The scheme of treatment at Chilaw is based broadly speaking upon the effect of artificial as compared with natural cultivation; using the former term to mean particularly the application of artificial manures and the latter the utilization of natural resources at hand. Interest at the present moment centres chiefly on the dry-farming plots which are ploughed twice a year and harrowed monthly to maintain a soil mulch and check the evaporation of moisture. It is, of course, too early as yet to draw any conclusions. The two plots which show the largest percentage of increase in the January-February picking, 1916, as compared with that of 1915 are the Dry-farming plots, 2 and 12; but No. 12 was dressed with sulphate of ammonia in 1915. The present appearance of these plots has induced many proprietors to adopt this system of ploughing and harrowing for working their plantations. It is

labour-saving; it conserves the moisture in the soil for the use of the palms, and it keeps the soil in good condition. A distinction should be drawn between a naturally fertile soil and a soil in good condition. Fertility may be judged by the total amount of essential food constituents such as nitrogen, phosphoric acid and potash present; condition by the amount that is available for the plant, that is to say soluble. Availability is promoted by cultivation. No amount of cultivation could convert say a poor sandy soil into an intrinsically richer soil such as a rich clayey loam; on the other hand a rich soil can be brought to a low state of productiveness by bad husbandry.

Harrowing at Chilaw is done by a disc harrow of eight plates, four on each leaf, or by the Planet Junior horse hoe, No. 4 in size. In this connection we refer our readers to two letters from Colombo firms (published on pages 295 and 296) on the subject of the increase in the demand for ploughs, disc harrows and horse hoes which has arisen recently. The manures for the plots were applied by weighing the exact amount of each ingredient required for each tree, a more accurate method than bulking the ingredients and then dividing the mixture into the requisite number of tree-portions. Plot 14 is against a sheet of water and is irrigated by hand, that being the cheapest and simplest method in the circumstances. A shallow trench is dug round each tree 7 feet from the base and 24 gallons of water are poured twice a week into the trench which is kept covered with a loose soil mulch.

The records for Pitiakande, near Kurunegala, are also published. These experiments are being carried out under the advice of the Department of Agriculture by MR. C. DE E. COLLIN, Superintendent of Pitiakande Group. Here also it will be necessary to take each plot as its own control and on applying this test we find again that the dry-farming plot, No. 4, comes out best with an increase of 93 per cent. in the yield of 1915 over that of 1914. The estate mixture which is producing good results consisted of 2 lb. kainit, 2 lb. castor cake, 10 lb. steamed bone meal and one pound basic slag per tree applied in February. The most noteworthy feature of this mixture is

the preponderance of phosphoric acid. Each tree was given 2·40 lb. phosphoric acid, 0·40 lb. nitrogen and 0·26 lb. potash.

In the experiments with old coconut trees which have been in progress at Peradeniya since 1911, Plot 8 which was ploughed twice annually to keep a loose surface and drive the roots down but not harrowed gave no conspicuous results. The rainfall is ample for coconuts; nevertheless we believe that monthly harrowing would prove beneficial, and it is being practised on a plot of young trees not yet ready to furnish us with results. The most remarkable feature of these Peradeniya Experiments as shown by the tabulated increase in yields is the behaviour of Plot 13, cattle tied. This was the worse plot in the series, yielding only 16 nuts per tree in 1911, but it has now reached third place with an increase of 212 per cent. We may count it as equivalent to farmyard manure. This is the most perfect of complete manures and it is significant that the other complete mixtures, plots 5 and 2, are also high up. The latter was dressed with sodium nitrate, sulphate of ammonia, concentrated superphosphate and kainit and increased its yield 134 per cent. Nitrate of soda alone at the rate of 150 lb. per acre, plot 3, also came out well. Potash alone, Plot 2, did poorly, while the only plot that declined in yield was plot 1 which was slowly being poisoned with common salt.

R. N. L.

ROOT PRUNING.

We take the following description of this operation from a little work entitled THE FRUIT GARDEN IN INDIA compiled by an officer of the Government Botanic Gardens, Saharanpur, N. India:—

This operation is performed in the case of those fruit trees which make a free growth, but produce little or no fruit. This operation also requires skill and experience. To do this properly, dig a trench in winter 3 feet deep around the tree and about six feet away from the main stem. Any root met with while digging the trench should be cut back to its inner side. If only few roots are met with at the above-named distance from the main stem, then dig gradually closer to the latter all around until you reach a point where root growth is profuse. Then cut off all the main roots to be seen with a sharp knife. When this has been done, mix the turned out soil with one or two dozen baskets of manure and return it to where it was taken from.

COCONUTS.

COCONUT EXPERIMENTS OF THE DEPARTMENT OF AGRICULTURE.

CHILAW COCONUT TRIAL GROUND, 1915.

The crops on the western portion of the estate (including the Trial Ground) Fields Nos. 3, 4, 5 and for the whole estate in 1914 and 1915 are as follows :—

Trial Ground portion of Estate (i.e. Western portion.)

	Average number of nuts per picking.	Total number of nuts.	Average number of nuts per tree for year.
1914	3,469	204,780	59·02
1915	3,535	148,436	41·99

Whole Estate Crop Statement.

1914	14,223	1,011,488	71·12
1915	14,296	834,028	59·04

Crops from the 15 plots of the Trial Ground.

1914	—	—	—
1915	1,289	46,777	34·68

YIELD OF NUTS, 1915.

Plot No.	Treatment.	Bearing Palms.	No. of mature nuts.	Average per tree.
1	Clean weeding	47	1,931	41·08
2	Dry farming	72	2,804	38·9
3	Groundnut cake	89	3,581	40·2
4	Steamed bonemeal ...	81	4,429	54·7
5	Sulph. of Potash	84	3,542	42·2
6	Sulph. of Ammonia ...	78	3,820	48·10
7	Mineral Mixture	92	3,304	35·9
8	Lime and Dry Farming ...	68	2,674	39·3
9	Org. mixture and clean weeding	85	3,383	39·8
10	Central (large weeds removed)	107	2,933	27·4
11	Ring mulching	100	2,861	28·6
12	Dry farming	101	2,936	29·07
13	Dry farming and manure ...	99	1,859	18·7
14	Irrigation	81	2,338	18·4
15	Dry farming	46		
16	Control	59	2,373	40·2

N.B.—Plot 14 is divided from January, 1916, into two of 81 and 46 palms, respectively, the former to be irrigated and the latter to south of road put under dry farming.

Plot 15 to be plot 16; no treatment to be given.

RAINFALL AT CHILAW.

Month.	1913.		1914.		1915.	
	Rain.	No. of wet days.	Rain.	No. of wet days.	Rain.	No. of wet days
January ...	8·45	7	1·13	3	5·95	9
February ...	2·23	4	·28	2	·60	2
March ...	·80	2	3·23	6	1·96	5
April ...	7·45	8	5·30	5	7·10	12
May ...	1·74	4	3·24	8	3·83	6
June ...	1·35	7	4·07	9	3·13	10
July ...	1·89	5	1·41	2	4·77	12
August ...	nil	nil	nil	nil	nil	nil
September ...	0·51	1	1·65	6	1·48	5
October ...	5·15	11	14·29	21	2·38	4
November ...	10·00	10	14·02	10	20·85	18
December ...	9·30	16	11·39	11	1·28	3
	48·90	75	59·74	83	53·33	86

NOTES.

Largest crops generally from April to August, dependent on rainfall about 11 to 12 months previously.

Cost of collecting and picking with bamboos, 60 cts. per 100 trees.

Cost of collecting and picking by climbing, Rs. 1·50 to Rs. 1·75 per 100 trees.

Cost of cleaning trees by climbing, Rs. 1·50 to Rs. 1·75 per 100 trees.

Cost of husking and curing, Rs. 1·37 to Rs. 1·50 per 1,000 nuts. Buyer finds bags and weighs for transport.

Cost of collecting nuts and making 1 candy of copra (1,200 nuts), Rs. 3.

January-February, 1916.—The January-February picking numbered 8,982 nuts (average per palm 7·92) as compared with 6,785 (average per palm 5·25) for the same period last year.

JANUARY-FEBRUARY PICKING OF 1915 AND OF 1916.

Plot.	Treatment	Palms in bearing.	1915 Jan.-Feb.	1916 Jan.-Feb.	Increase per cent.
1	Weeded	47	336	391	16
2	Dry farming*	72	314	668	112
3	Organic nitrogen ...	89	460	673	46
4	$P_2 O_5$ ...	81	602	732	21
5	Potash	84	468	678	45
6	Mineral nitrogen ...	78	630	534	15†
7	Mineral mixture ...	92	504	637	26
8	Dry farming and lime ...	68	591	323	45†
9	Organic mixture ...	85	556	682	23
10	Control	107	518	711	37
11	Ring mulching ...	100	506	556	10
12	Dry farming	101	420	636	51
13	Dry farming and organic mixture	99	250	565	26
14	Irrigation	127	330	380	15
15‡	Dry farming	—	—	411	—
16	Control	59	300	405	35

Plot 12 was worked with the Planet Jr. cultivator.

Plot No. 15 is under irrigation. It was originally intended to use a water cart but on the suggestion of MUDALIYAR A. E. RAJAPAKSE it was decided that the area should be hand-watered, this being the simplest and most practicable method under the existing circumstances. This was accordingly carried out. Two zinc baths were placed on the bank of the river and filled by a cooly; while two other men drew the water from the baths in cans of a capacity of 3 gallons and applied it to the trees. Before the water was applied a shallow trench 1 foot wide and a few inches deep was dug round the trees at a distance of 7 feet from the base. When the water had soaked into the ground the soil which had been dug was loosely thrown over the trench to act as a mulch. In future the whole area will not be exposed but 8 holes will be dug in the area of the circle and the proper quantity applied to each, after which the holes will be closed up. The trees are to be watered twice a week, each tree receiving 24 gallons at each watering.

PITIAKANDE COCONUT EXPERIMENTS.

Plot.	Treatment	Nuts per tree. 1914.	Nuts per tree. 1915.	Increase per cent.
1	Estate mixture	64	103	61
2	Lime	59	96	63
3	Ploughed twice yearly	37	68	84
4	Soil stirred monthly	28	54	93
5	Cattle tied	44	55	25
6	Control (in grass)	43	48	12
7	Phosphoric acid omitted	49	59	20
8	Mineral mixture	49	55	12
9	Organic mixture	30	37	23
10	Control	27	34	26
11	Potash omitted	53	38	28§

* Sulphate of Ammonia, 1915.
† Decrease.
‡ Plot 14 was divided into two from January, 1916.
§ Decrease per cent.

PERADENIYA EXPERIMENTS WITH OLD COCONUT TREES.

Plot Treatment.	nuts per tree 1911	1915	Increase per cent.
1. Common salt, 500 lb. per acre	54	32	41*
2. Sulphate of potash, 200 lb. per acre ...	25	28	12
3. Nitrate of soda, 150 lb. per acre ...	17	33	94
4. Concentrated superphosphate, 200 lb. per acre ...	24	39	62
5. Organic nitrogenous mixture, 800 lb. per acre ...	31	57	83
6. Digging in green manure with basic slag and sulphate of potash ...	29	56	93
7. Green manure with basic slag and sulphate of potash ...	27	49	81
8. Ploughing twice annually ...	29	44	51
9. Inorganic nitrogenous mixture, 750 lb. per acre ...	23	54	134
10. 300 lb. lime followed by No. 5 mixture ...	26	38	46
11. Green manure with slag and sulphate of potash ...	23	36	56
12. Cattle tied two weeks and circle 10 ft. dug ..	22	43	99
13. Cattle tied two weeks every three months ...	16	50	212
14. Control ...	31	42	35
15. Control ...	24	39	62

DRY FARMING IMPLEMENTS.

The DIRECTOR OF AGRICULTURE has received the following letter from MESSRS. BROWN & CO., LTD., of Colombo:—

"We have the honour to inform you that our sales for Disc Harrows are certainly going up. We find that our clients like the MASSEY-HARRIS 12 Disc machine, but in several sales lately we have cut the machine down to an 8 disc machine, the parts, thimble, washers and discs coming in handy as spares later on.

"The MASSEY-HARRIS Co., of Toronto, Canada, do not list a smaller machine than the 12 disc, and we are endeavouring to get a lighter 8 disc machine, but the industrial conditions of the whole world are pretty well upset at present and we are not hopeful of having them here for some considerable time. The abnormal condition of shipping is practically throttling American supplies, and we are only receiving occasional and very limited shipments.

* Decrease per cent

"Planet Junior cultivators show a slight increase, and we find the No. 4 without the adjustable handle the most popular machine. No. 8, although theoretically a handier machine, does not seem to be so suitable for native labour. We realise that labour-saving appliances are now appealing to cultivators."

MESSRS. BROWN & CO. also enclose the following copy of a letter which they have received from MR. R. H. SPENCER SCHRADER of Wester Seaton Estate, Negombo :—

"With reference to your letter of 5th instant, I use a pair of ordinary Sinhalese buffaloes to draw the Disc Harrow. Buffaloes can be trained to draw in a few days and are not only very satisfactory, but are by far the cheapest. The only drawback is that buffaloes cannot be used in the heat of the day. I use them generally between 6 and 10 a.m. The acreage ploughed in any one day would necessarily vary with the depth of the furrow approximately; however, I cultivate an acre in four hours.

I do not know what the life of one of these instruments is, but taking it that it can cultivate only 10,000 acres I work out the cost of working one acre at 50 cents. For hand tilling the cost is about Rs. 5·00."

THE COLOMBO STORES, LIMITED, write under date April 19th, 1916, as follows :—

"We have had a great demand for ploughs of various kinds for the past year. With regard to Disc Harrows we have sold several for this year which are giving entire satisfaction, and have now imported the 8-plate harrow for which there seems to be a great demand."

COPRA FROM QUEENSLAND.

The cultivation of the coconut in Queensland was at one time confined to a few islands off the Torres Straits but is now rapidly extending southwards. The total area under the palm in 1913 was 549 acres, as compared with 365 acres in 1912. Copra first appeared in the agricultural statistics in the latter year, when the production of 31 tons was recorded.

It has been stated that there is a general opinion that coconuts grown in Queensland do not contain sufficient oil to be of commercial value, and in order to test the point a sample of copra was forwarded to the Imperial Institute for examination in July of this year (1915).

The sample which was produced at the Kamerunga State Nursery, Cairns, North Queensland, consisted of clean, well-prepared copra from fair-sized nuts and was in good condition, only a few of the pieces being slightly discoloured.

The copra contained 4·4 per cent. of moisture and yielded 64·6 per cent. of oil: equivalent to 67·6 per cent. on the dry copra. The oil possessed the usual characters of coconut oil and was of good quality, the acidity being very low.

The yield of oil from this sample of Queensland copra is quite equal to that furnished by other varieties of commercial copra. Kiln-dried copra is stated to yield from 63 to 65 per cent. of fat, whilst copra dried in hot air

gives a higher yield which sometimes reaches as much as 74 per cent. There is no doubt that copra containing 67·6 per cent. of oil in the dry material would meet with a ready sale if placed on the market in good condition.

The sample was submitted for valuation to a firm of oil-seed crushers, who treat copra, and also to brokers. The oil-seed crushers reported that the copra was of very fair quality, but they pointed out that it would be desirable to reduce the amount of moisture from 4·4 per cent. to about 3 per cent. They stated that the excess of moisture makes a considerable difference in the value of the copra for crushing purposes, as it renders the material more difficult to grind and consequently reduces the yield of oil obtained on pressing. They valued the sample at about £25 per ton c.i.f., London, (October 11, 1915) and stated that a little extra drying and, if necessary, the breaking of the copra into rather smaller pieces would increase its value by about 10*s.* per ton.

The brokers described the sample as sun-dried copra of good colour and valued it at £24 15*s.* per ton c.i.f. London (October 6th, 1915).

For comparison with these valuations, quotations for the chief commercial varieties of copra in London, on approximately the same dates, are given below:—

NOMINAL QUOTATIONS FOR CURRENT SHIPMENTS OF COPRA TO LONDON.

			October 6, 1915, per ton.			October 13, 1915, per ton.		
			£.	s.	d.	£.	s.	d.
Malabar	...	Bags	26	0	0	26	15	0
Ceylon	...	,,	25	0	0	26	0	0
Java	...	,,	25	0	0	26	5	0
Singapore	...	,,	24	2	6	24	12	6
Straits	...	,,	23	17	6	24	10	0
Mozambique	...	,,	23	5	0	24	5	0
Manila	...	Bulk	23	0	0	23	12	6
Cebu	...	Bags	23	7	6	24	0	0
Macassar, etc.	...	,,	23	12	6	25	0	0
Zanzibar	...	,,	24	5	0	24	15	0
South Sea	...	,,	22	15	0	23	12	6

The results of this investigation show that the Queensland copra contains a normal amount of oil and that commercial shipments would be readily saleable in London at good prices, especially if care were taken to dry the copra so that it contains not more than 3 per cent. of moisture.

Until recently the bulk of the copra shipped to Europe was crushed in France and Germany. On the outbreak of war, British producers of copra in Ceylon, India, and elsewhere were placed in a serious position, owing to the fact that their produce had hitherto been marketed in Germany and that the war had closed that market. In order to overcome this difficulty the Imperial Institute issued a special circular to British oil-seed crushers calling their attention to the importance of the copra-crushing industry. As a result, a number of British firms have started the crushing of copra and there is now a good market for copra in this country.—IMP. INST. BULL.

COCO DE MER.

W. B. HEMSLEY.

Much has been written on this singular palm, and its history has been fully recorded, but in my investigations of the flora of Seychelles I have collected evidence on two or three points which were somewhat obscure. Generally, in this country, the botanical name of *Lodoicea sechellarum* is current, and it is the one adopted by the majority of botanists of all countries: but for various reasons other specific names have been published, and sometimes without the corresponding synonyms, giving rise to the supposition that there is more than one species of Double Coconut. Other names coupled with the generic name Lodoicea are: *L. callipyge*, *L. maldavica*, and *L. Sonneratii*. The first was given by COMMERSON in his manuscript account of the palm, but it was not adopted by LABILLARDIERE, who published the earliest botanical description under the general designation of Lodoicea. The name *callipyge* has been revived by some writers, and it is used. without any synonym, in account of germination in a Dutch horticultural publication of 1911.

With regard to the natural distribution of the Double Coconut in the Seychelles, there have been differences of opinion, some writers recording it as confined to Praslin (where COMMERSON discovered it) in a truly wild condition. J. HARRISON, who supplied the material and information for the Botanical Magazine (plates 2, 734—2, 738), 1827, adds the neighbouring Curieuse and Round Islands.

Writing in 1868, DR. PERCIVAL WRIGHT states that "the island Curieuse was the headquarters of Lodoicea. In 1829 this island was selected for a leper establishment, and a MR. GEORGE FORBES was appointed overseer. He was specially instructed not to permit the leaves of the Coco de Mer to be cut nor the nuts to be eaten. Further, he was to plant once a month all mature nuts found on the ground. These instructions were carefully followed out for forty years."

On the other hand, DR. J. STANLEY GARDINER was of opinion that the Double Coconut "was only indigenous in Praslin, and supposed to have been transported to Curieuse by human agency." In reply to my inquiries, MR. P. R. DUPONT, Curator of the Botanic Station, Mahé, writes: "I personally think that the Coco de Mer is indigenous to Curieuse and to Round Island, where there are traces of very old trees on accessible parts. For instance, the famous 'bowl' can be seen in the ground on the hills of Round Island and Curieuse, and on the latter island, besides trees which have been planted near the paupers' camp, there is a great number of very old trees on the summits, where they had certainly not been planted. The soil on the summits of Curieuse is denuded, and the Coco de Mer trees remain stunted, while in Praslin they reach lofty dimensions only in damp valleys. There is no reason why this palm should not have existed in the whole of the Praslin group, which is of granitic formation."

It is well-known that the Double Coconut is usually two-lobed, sometimes three-lobed, and very rarely six-lobed, the last being a complete and perfect development of the three-celled ovary. Male and female flowers are borne on separate individuals, but some confusion has been caused by the

popular use of these terms, two-lobed fruits being known as female and three-lobed fruits as males. Commonly, all the nuts of a tree are either two or three-lobed: occasionally they occur intermixed.

The Double Coconut Palm, besides bearing the largest seed-vessel known, presents some other physiological peculiarities. PROFESSOR STANLEY GARDINER collected such information as he could on the spot, according to which germination takes about three years. Male trees bear their first flowers when about 45 years old, the female trees their first when about 65 years old, and the nuts take seven to nine years to ripen. There is little doubt, however, that these functions and phases are influenced by local conditions, though always of relatively long duration. Particulars of the germination of this palm will be found in the GARDENERS' CHRONICLE for 1888, ii., p. 732.

[Few, if any, plants have aroused as much curiosity as the Double Coconut. From the fact that the fruits are frequently found floating on the Indian Ocean, it was alleged that the tree which produced them is a submarine vegetable. GENERAL GORDON (see GARDENERS' CHRONICLE, Vol. iv., 3rd series, 1888, p. 732) put forward in all seriousness the belief that the fruit *Lodoicea sechellarum* is the "Forbidden Fruit," the instrument of "man's first disobedience," and maintained in conformity with this hypothesis that the Garden of Eden was situated in the Seychelles Islands. Those interested in the plant rather than in the legends and superstitions which it has called forth, may see at Kew a specimen still—or until recently—in the course of its leisurely germination. This specimen when three years old was figured in the GARDENERS' CHRONICLE (XIII., Jan. 21., 1893, p. 74), and although the first leaves had attained a considerable size, the "seedling" had not yet been weaned, but still remained attached to the parent fruit by means of its elongated cotyledon. Although at first sight very remarkable, the seedling follows the pattern of many monocotyledons. The embryo, at first very small, develops a tubular leaf-stalk, the apex of which, remaining within the seed, becomes sucker-like, and serves to absorb and transfer nutriment from the stored-up food of the seed to the young stem and root. The cotyledonary leaf-stalk elongates to form a long tube, which bears at its free end the rudiments of the root and stem. After the tube has passed out of the fruit the stem rudiment forms a leaf, which pushes out from a split in the base of the cotyledonary leaf into the open air, just as does the first leaf of a wheat grain. This is followed by a second leaf, and so on, and during this time adventitious roots, developing at the base of the stem, fix the plant in the soil.—EDS.]—GARDENERS' CHRONICLE.

Six pounds of *Solanum commersoni* were planted at Hakgala in a 242 sq. ft. plot on 13th December, 1915, and harvested on 9th March, the yield being 60 lb. or at the rate of $4\frac{3}{4}$ tons per acre. Tubers from this crop have been distributed to the following:—MESSRS. C. E. HASLOP, S. F. JOHNPULLE, S. W. ANDERSON, R, SIVAGANANAM and H. D. ELHART.

J. J. N.

RUBBER.

A NEW BULLETIN ON RUBBER TAPPING.*

(Continued from p. 76 Vol. XLVI.)

A large part of MR. BATESON'S pamphlet is devoted to the question of latex formation, etc.

In the first place he demonstrates that latex is formed in cells which have recently been cut off from the cambium. If a piece of bark be removed from the wood, cambial regenerations may take place, little bark-islands being formed. If one of these bark islands be pricked it will bleed latex. As there are no means of communication with the rest of the bark on the tree, and also as there are no latex vessels in the wood, the latex must have been formed in cells cut off by the cambium.

As far as the role of latex is concerned MR. BATESON remarks that the balance of probability is in favour of the theory that latex tubes are merely excretory reservoirs.

It is, of course, a fallacy to suppose that when a tree is rested all the latex is stored up and can be obtained whenever the tree is tapped, for in untapped trees the fate of latex is to be dried up in the outer cortex and finally to be cast off in the shedding of the "cork."

In offering an explanation of the probable reasons for the superiority of the adjacent quarter system of tapping over the single and opposite quarter systems, MR. BATESON attributes to root pressure the differences observed. In a tree tapped on adjacent quarters the latex, seeking to pass upwards, has only two sideway paths. In the opposite quarter system it has four and will therefore escape more rapidly and the pressure in the bark below the cuts will not be so great as in the other tree. Similarly, the advantage shown by the adjacent-quarter system in causing more starch to be stored in the renewing bark may be explained in the same way.

Two short tapping cuts by providing a side track at each of the four edges would allow more food to pass into the *untapped* bark than one large cut, which provides only two side tracks. The *renewing* bark would therefore suffer by the loss of this starch.

Our present tapping knowledge leads us to anticipate that the adjacent quarter system (or one cut over a half of the tree's circumference) will prove superior to two cuts on one quarter.

In MR. BATESON'S opinion there is no doubt that if trees growing in a soil of average fertility be allowed sufficient space, four years will be found enough for bark renewal. Some interesting remarks are made with reference to overcrowding. When a tree attains a girth of 45 inches the increase in girth will, if the amount of food available remains constant owing to the limitation of the size of the 'crown,' be only two-thirds as rapid as when the circumference was 30 inches. This would mean that bark renewal would take 6 years instead of four.

* F. M. S. Department of Agriculture, Bulletin No. 23.

When trees are close planted, the phenomenon of "drawing-up" of the crown is observed; the crown climbs higher and higher and the food material which might have been used to add thickness to the tappable part of the trunk goes to the formation of long bare stems and branches. Thinning out should therefore be done before "drawing-up" has commenced.

To what extent it will ultimately be necessary to reduce the number of trees per acre cannot as yet be stated.

On the subject of burr-formation Mr. Bateson makes some observations of considerable interest. In the first place the formation of burrs appears to follow coagulation of the latex in the latex tubes, this coagulation in all probability being due to the stagnation of the latex.

Anything therefore which causes isolation of latex vessels may be expected to give rise to burrs.

Three causes of isolation are leaf-fall, disease, and wounds.

When a leaf is shed, latex vessels are cut across and left ending blindly in the cortex—subsequent growth of the tree may completely isolate these vessels.

It has been reported from Buitenzorg that burrs develop in the bark which has been attacked by canker. Canker kills patches of bark and completely or partially isolates latex vessels in the adjacent healthy bark. Mr. Bateson detected the presence of latex vessels in the cores of burrs formed in cankered bark.

Exhaustive tapping also favours the development of burrs owing to the very slow renewal which ensues. The better the tapping and the quicker the bark renewal, the smaller will be the chances of burrs developing.

In addition to the various subjects mentioned above, Mr. Bateson discusses the artificial stimulation of branching and has also reproduced photographs illustrative of Callus formation, etc.

The writer of this article has only briefly described some of the results and conclusions arrived at by Mr. Bateson. The acquisition and study of the bulletin itself is recommended to all interested in rubber plantation work.

L. E. C.

RUBBER FROM ALCOHOL.

I. I. OSTROMISLENSKIJ.

The process of preparing rubber from alcohol, which the writer has already patented, consists practically of two phases.

I. A current of air is pumped through a copper vessel containing the alcohol; the mixed vapours of alcohol and air formed during the passage of this current pass through a series of copper tubes in which are arranged spirals of gauze of red copper and silver. These gauzes are first heated to a dark red heat, and during the manufacturing process, thanks to the great amount of heat evolved in the reactions, remain always incandescent. The mixture of alcohol and air makes its way to the gauzes; the products of the reaction escaping are acetic aldehyde, paraldehyde, water and some of the

alcohol. The rest of the apparatus necessary for this first phase consists of refrigerators and recipients for the separation and fixing of the products obtained. The reaction is produced rapidly, and the amount of the product obtained comes up to the quantity calculated. The expense of rendering the gauzes incandescent is small, seeing that it is only done at the beginning of the operation and that the apparatus can afterwards continue working for several months without interruption. As for the work of the pump, the cost of this is insignificant; the same may be said for the necessary expenses of producing the steam which heats the alcohol to the temperature of 50°C. The process requires no other substances but alcohol and air. The metallic gauzes are consumed very slowly during the operation, as in any other chemical industry.

From 100 parts of 100 per cent. alcohol are obtained 87 to 90 parts of acetic aldehyde or paraldehyde; from 100 parts of 90 per cent. alcohol 78 to 81 of absolute aldehyde.

II. The acetic aldehyde or paraldehyde obtained during the first phase of the operation is mixed with alcohol at 70–90 per cent; the mixture is then passed, in a gaseous or liquid state, through a series of metal tubes containing aluminium oxide heated to 440°–460°C. By this means a volatile carbohydrate, erythrene, is produced; this is collected, either in a gaseous or a liquid condition, in an autoclave.

It is from this moment that the conversion of erythrene into rubber begins. In the autoclave, or in parts of the apparatus where the erythrene is collected, is placed a small quantity of a catalysing substance. The crude rubber obtained is treated with water and dried, as is done in the case of natural rubber, or else dissolved in benzine, after which the catalysing substance is eliminated by mechanical means and the benzine is removed by steam.

Erythrene rubber is a pure chemical product of formula $(C_4 H_6)n$. In this condition, the chemical properties of the rubber are different from those of natural rubber, or rather we should say, this synthetic rubber is identical with chemically pure natural rubber, though not with natural rubber as placed on the market. Thus raw erythrene rubber on exposure to air, oxidises more rapidly than the natural product, forming on its surface a crust of unknown composition; hence the necessity of protecting erythrene rubber from the action of air. Another essential difference between the two rubbers is that when subjected to vulcanisation by the action of sulphur alone, erythrene rubber gives a very fragile product, and the vulcanisation process requires much time, so that rubber decomposes before the process is complete. Vulcanisation takes place at a temperature of 135°C.

From the commencement of the experiment, the writer says, it was evident that, in order to give the synthetic rubber all the qualities of the natural product, it would be necessary to add to it a certain number of the substances that are found in the latter. The experiments carried out for this purpose showed that these substances are represented by the following three groups:—

(1) Substances preserving the rubber from decomposition when in contact with air.
(2) Substances accelerating the vulcanisation process.
(3) Substances increasing the elasticity and resistance of the rubber.

The first group consists of tannic compounds, but these have a negative influence upon the quality of natural rubber. The writer succeeded in replacing them by others possessing their good qualities and free from their defects, namely nitrobenzol and its derivatives, and sulphur.

The second group contains nitrogenous substances of undefined composition. According to the writer, they can be replaced by pure nitrogenous compounds, such as diethylamine mixed with oxides of lead, zinc and magnesium. These oxides are inevitably introduced into the rubber when it is vulcanised by the action of sulphur, so that they cannot be unnecessary. The addition of amines brings about surprising effects: 3·3 to 17·6 lb. of amine to 3,432 lb. of rubber accelerate the vulcanisation 40 times.

The third group consists of the so-called "rubber resins"; these are of different chemical composition and structure. The writer states that their place can equally well be filled by colophony, Canada balsam, etc.

In all, it is necessary to add about 15 per cent. of foreign substances to the synthetic rubber obtained from alcohol.

From 100 parts of alcohol the process gives 14 to 18 parts of chemically pure rubber, or 16 to 20·5 parts of the commercial product (including secondary substances, such as colophony, amines, etc.).

On the initiative of the General Direction of Indirect Taxation of the Ministry of Finance, this method of preparing rubber from alcohol has been subjected to qualitative and quantitative tests; the latter were finished in June, 1915.—BULL. INT. INST. OF AGRIC.

THE CLIMATE OF THE PRINCIPAL RUBBER COUNTRIES.

In an article on the climate of the principal rubber producing countries, W. VAN BENNELEN (in "International Rubber Congress met Tentoonstelling," Batavia, September, 1914. "Rubber Recueil," Amsterdam: J. H. DE BUSSY 1915, pp. 145-166, pl. 1), describes the climate of the Amazon and Congo basins, Ceylon, Malacca, Sumatra, Borneo, and Java as follows:—

It is stated in general that "the climate of these countries is purely tropical; that is to say, warm, damp, and equable. The temperature in the plains is 25 to 27° C., (77 to 80·6° F.) declining above the sea level at the rate of about 0·6° for every 100 meters (1° F. for every 300 feet). The percentage of moisture in the air is great, and as a result the pressure of aqueous vapour is proportionately high (× 20 mm.) and the rainfall is more abundant (2,000 mm. = 79 inches and more per year); above all, however, its evenness is the most conspicuous feature of the climate. The yearly rise and fall in temperature amounts to only a few degrees and the daily difference far exceeds the yearly, though even that is not excessive. Periods of drought are seldom of longer duration than two months. The force of the wind is slight, and storms are practically unknown; there are merely the gusts which are forerunners of the many thunderstorms, and these can be pretty violent."—JOUR. OF THE BOARD OF AGRIC., BR. GUIANA.

COCOA.

PACKING COCOA SEED FOR TRANSPORT.

The following report on the Germination of Cocoa Seeds has been received from MR. J. N. MITSUM, Superintendent of Government Plantations, Selangor and Negri Sembilan, by the Secretary, Ceylon Agricultural Society.

1. 6 pods gathered on 22nd January, 1916, and packed in charcoal. Despatched from Colombo 6th February, 1916. Arrived at the Experimental Plantations, Kuala Lumpur, 21st February, 1916. In two pods signs of decay were evident. Several seeds had commenced to germinate. The seeds and pods appeared to be more mature than those in the treated pods. (2) The seeds were planted on arrival singly in bamboo baskets and shaded. Number of seeds received, 230.

On the 5th March, 1916, 50 per cent. of the seeds had germinated. On the 15th March, 1916, 200 of the seeds had germinated and in the majority of cases were showing their first leaves. The remaining 30 seeds had failed to germinate and had decayed. Germination 87 per cent.

2. 6 pods gathered and prepared on 21st January, 1916, by dipping in alcohol, corrosive sublimate, and paraffin wax. Despatched from Colombo 6th February, 1916. Arrived at the Experimental Plantations, Kuala Lumpur, 21st February, 1916. The seeds and pods did not seem to be so mature as those of No. 1. The outer covering of the seeds was very damp. No signs of germination was evident. The seeds were planted on arrival singly in bamboo baskets and shaded. Number of seeds received 277.

On the 15th March, 1916, the seeds were examined and all found to be decayed and dead. Germination nil.

3. 6 pods gathered on 22nd January, 1916; seeds extracted, washed, sundried, and packed in damp mould and charcoal. Received by parcel post at the Experimental Plantations, Kuala Lumpur, 16th February, 1916. The seeds were in rather a heated condition due probably to germination, which in many cases had commenced. The seeds were planted on arrival singly in bamboo baskets and shaded. Number of seeds received 360.

On the 15th March, 1916, 100 of the seeds had germinated and were growing well. The remaining 260 seeds had not germinated and upon examination were found to be rotten and dead. Germination 28 per cent.

Sgd. J. N. MITSUM,
Superintendent of Government Plantations,
Selangor and Negri Sembilan.

NOTES ON THE BUDDING OF CACAO ON AN ESTATE SCALE IN TRINIDAD.

W. G. FREEMAN.

Before dealing with the more recent work on budding I wish to make a few remarks on the grafting of cacao.

That the grafting of cacao was possible was demonstrated by plants exhibited before this Society, by MR. J. H. HART, in September, 1898. (PROC. AGR. SOC., iii., 121 and 131). A few plants were established at St. Clair, and there are others on at least one estate in the Colony, but up to 1912 nothing on an estate scale appears to have been attempted in this direction. There is now half an acre in grafted cacao at St. Augustine Experiment Station. One acre has also been laid out at River Estate as part of an experiment.

In Dominica plots of grafted cacao were established at the Botanic Station from 1906 onward by MR. JOSEPH JONES. I recently had an opportunity of seeing these and, as the photograph exhibited shows, the trees are of a low bushy habit. Although small, compared with seedling trees, they bear well. One plot of 28 trees, planted out in 1906 and 1907, is giving now an average of 126 pods per tree. A second plot of 52 trees, established in 1907 and 1908, is giving 85 pods per tree; in 1914 the yield was 149·6 pods but was reduced by an attack of root borers from which most of the trees suffered and 10 died.

A third plot of 30 trees, dating from 1910, is yielding 41 pods per tree. Under the conditions at the Dominica Botanic Station grafted trees come into bearing early and give good returns. Full particulars regarding these experiments will be found in the *Annual Report* of the Agricultural Department, Dominica.

Budding of cacao in our colony practically dates from 1913. Two plants had been done earlier in Tobago, but the percentage of failures was so high that the method did not appear likely to be of any estate value. In November, 1913, I exhibited plants at the Board of Agriculture and explained how MESSRS. J. C. AUGUSTUS and J. DE VERTEUIL had obtained 16 budded plants from 40 attempts. (See BULL. DEPT. AGR. xii. 217-21.) In July, 1914, this Society attended a practical demonstration at St. Clair Experiment Station, where the method of budding cacao in bamboo pots in the nursery was shown and the history of budding briefly re-capitulated. (See PROC. AGR. SOC., xiv. 267, and BULL. DEPT. AGR., xiii., 235). During 1915, budding has been steadily persevered with at St. Clair, 100 to 200 plants being done each month. The successes have ranged from 36 to 71 per cent. The lower yields were due mainly I believe to the use of stocks which were rather too old. These plants have all been selected Forastero on Calabacillo stocks.

Budding has also been successfully carried on during 1915 at the Tobago Botanic Station, and two small plots established, one of eighteen plants and the other of six, the latter being budded Nicaraguan Criollo.

From plants budded at St. Clair in 1914 and early in 1915, half an acre has been established at St. Augustine. They have made good growth; a well developed specimen planted in July, 1915, is now about 3½ feet high.

Budding of cacao has been accomplished in a good many countries, but there is little if any exact information available from them as to whether it is a desirable method for planters to adopt on an estate scale.

It is an important part of the work of a Department of Agriculture to attempt to decide definitely questions of this character. Even if the results proved that the method was not desirable, it was important, as it saved planters wasting money in useless directions. To this end an experiment had been laid out on a larger scale at River Estate.

The other and not less important question as to whether we can use budding as a means of improving the yield of an established plantation, i.e., by budding on new growths from poor bearing trees, which have been cut back for the purpose, will be dealt with by separate experimental work.

In conclusion I wish it to be understood that the Department is not advocating that planters should as yet abandon seedlings and take up budding on an extensive scale. The Department is working along the lines indicated, to ascertain whether it should advise budding or not. Meanwhile it would be of benefit if as many planters as possible would give budding an experimental trial on a small or a large scale.—PROCEEDINGS OF THE AGRI. SOC. OF TRINIDAD AND TOBAGO.

SUGAR IN INDIA.

According to MR. SAYER, Assistant to the Agricultural Adviser to the Government of India, it is possible to produce all the sugar required by the Indian Empire by improving the methods of sugar manufacture, reducing waste and increasing the output.

India is the largest producer of sugar (crude cane sugar, mostly in the form of *gur*) in the world. The annual production in round numbers amounts to 3 million tons, cane sugar and *gur* about 2, 600,000 tons, palm sugar close on half a million tons. But the annual consumption is over $3\frac{3}{4}$ million tons, which leaves a deficit of over $\frac{3}{4}$ million tons which is met by importation of white sugar from Java and other sugar-producing countries. Our imports of this commodity amounted in 1913-14 to over 800,000 tons.

Can India, besides satisfying her demand for raw sugar, produce the 800,000 tons of white sugar imported from abroad? The official forecast of the current year's area sown with cane is about $2\frac{1}{2}$ million acres, so that if India is to be made self-supporting the cultivation of this crop would have to be enlarged by about 25 per cent. on the existing cultivation, or manufacturing yields should be increased so as to produce the required quantity of both raw and white sugar. It will at once strike any one who has studied the conditions under which sugarcane is grown and jaggery manufactured in this country that the margin for improvement is so enormous that it is not necessary to take the land from other food crops to increase the total outturn.—INDIAN TRADE JOURNAL.

Photo by H. F. Macmillan

REAPING PADDY.

Paddy grown under the new canal and drainage system, Experiment Station, Peradeniya.

RICE.

RICE GROWING EXPERIMENTS AT PERADENIYA.

The following report by MR. D. S. CORLETT refers to rice grown on the Experiment Station on land irrigated on the new canal and drainage system:—

LOCK'S SELECTED PADDY.

PLOT 1—ONE ACRE—TRANSPLANTED

July 15, 1915.—Nursery sown with ¼ bushel of selected seed from last crop.

September 6th.—Transplanted (6 weeks old) single plants 6 in. × 6 in. Insufficient plants to supply one-third of the plot.

September 20th.—Remaining one-third transplanted with plants thinned out from Plot II (broad cast). Total cost of transplanting Rs. 29. Water kept continuously on the fields to the depth of 2 in. only by re-watering every third day approximately. No weeding found necessary.

December 18th.—Paddy in flower. Water allowed 4 days on and 3 days off, i.e., watered once a week.

February 7, 1916.—Harvested (the one-third portion harvested on February 22nd 14 days later). Water completely drained off 10 days before harvest.

Result:—77 bushels of well cleaned paddy and 824 bundles of straw five feet long.

Value 77 bushels @ Rs. 2·15 ...	...	Rs. 165·55
824 bundles of straw @ Rs. 2 per 100 ...	,,	16·50=Rs. 182·05

197 days or 6½ months.

February 10th.—Land ploughed.

February 15th.—Disc-harrowed and sown with green manure.

PLOT II—1¾ ACRES—BROADCASTED.

August 23, 1915.—Seed broadcasted at the rate of 1 bushel per acre.

September 27th.—Weeded and thinned out by women. Cost of weeding Rs. 30.

December 27th.—In flower.

February 22, 1916.—Harvested.

Result:—62½ bushels paddy and 556 bundles of straw 4 feet long, i.e., 35½ bushels per acre and 317 bundles of straw per acre (i.e., less than half the yield of the transplanted plot).

35½ bushels @ Rs. 2·15 ...	...	Rs. 76·30
317 bundles of straw @ Rs. 1·50 per 100 ...	,,	4·70
	,,	81·00

Difference in value between one acre of transplanted and broadcasted is Rs. 101. 183 days or 14 days less than transplanted.

On the whole the transplanted plot occupied the better fields; a portion

of the broadcasted plot was affected by too much water due to springs in the field; but even so the difference in yield is very marked.

It will be noted that the cost of transplanting is counter-balanced by the cost of weeding the broadcasted portion; the transplanted portion required no weeding.

HONDARAWALA PADDY.

A quarter of an acre of this semi-hill paddy was sown broadcast and about half the amount of water given to ordinary paddy was supplied.

Sown September 6th, flowered December 15th, harvested January 1st, i.e., 116 days or nearly 4 months. The yield was only five bushels or 20 bushels per acre, and inferior straw 70 bundles or 280 bundles per acre.

PHILIPPINE PADDY.

A very small plot of this was planted 6 in. × 6 in. with plants supplied by MR. BEDDEWELA of Kandy.

Planted October 7th, flowered December 21st, harvested January 28th, i.e., 113 days or 4 months from sowing in the nursery. Yield, a quarter of a bushel of medium-sized, round grain containing very white rice. Straw very short. This variety may improve next crop and prove of value.

SOME OBSERVATIONS ON CHINESE RICE CULTURE.

H. O. JACOBSON.

The first distinct impression one receives is that no attempt whatever is made to cultivate rice on soil which is not particularly suitable for it. The habit of carefulness in adaptations of crops to soil and climate is not so marked with other crops, although it obtains to a high degree except in the culture of maize.

The rice fields are found only in the low, level districts, which are located in the river valleys and deltas. No littoral regions were visited. These soils are sedimentary, of fine texture and high initial fertility. Examples of sedimentation are apparent in every big river.

Given a soil of large proportions of silt and clay, a prime requisite is had for rice culture. Lying contiguous to large streams of fresh water the problem of irrigation is more easily solved and it has been solved in these regions. The canals and creeks intersect this area so completely that practically all the land planted with rice is easily irrigated.

The value of a soil for agricultural purposes depends upon the original material from which it has been derived and the state of fineness to which it has been reduced; in addition, for rice culture, there must be added the availability of ample amounts of water for irrigation. These conditions are found to a highly satisfactory degree in the district visited.

It is evident that these areas have been cultivated for a long period, and the question of maintaining soil fertility is certainly interesting. It is hardly probable that there is much organic matter in these soils, the physical appearance indicating the contrary. This should be a splendid field for

Photo by H. F. Macmillan.

STOOKING PADDY,
Experiment Station, Peradeniya.

those who have in recent years been in controversy regarding the ethics of fertilizing, to gather evidence to support their several divers theories.

One very apparent condition regarding which anything is seldom said, is that the huge areas of uncultivated lands and the waterways and lagoons contribute directly or indirectly to the maintenance of the fertility of the cultivated lands. Thus the herbage from the hills and the aquatic plants from the waterways and lagoons pass directly into the soil of the rice fields as green manure or compost. The waste from the fish and the manure from the animals fed with forage produced on the up-lands, also passes into the cultivated soils. When the high ratio of human population to animal population is considered, it is easier to understand how and why the use of night soil for fertilizer has become so common a practice. The importance of animal manure is relatively slight in comparison.

We have heard much about the value of night soil as a fertilizer, but judging by the yields obtained, and the general appearance of the crops viewed, it is the opinion of the writer that eventually it will be discovered that the practice must be amended to include the addition of certain elements in the form of chemical or artificial fertilizers to make maximum production possible.

To one who is accustomed to the large number of varieties of rice which abound in the tropics, the small number found as the northern limits of the rice region is approached is a feature that is appreciated. One of the greatest contributing factors to low yields and wastes in milling is the multiplicity of varieties which obtains in the tropical rice area. The number of varieties of rice grown in the district visited is much larger than it should be.

The appearance of the fields indicated that the soil had been very thoroughly prepared, and at harvest time the absence of weeds of all sorts was remarkable.

Irrigation is continued much later than is ordinarily considered essential. In many cases water was being applied when the harvest was due within two weeks. There appeared to be but one way of raising the water from the canal, creek or lagoon, and that was by means of an endless wooden chain running in a trough, operated by a treadmill, or, in other instances, by a bullock or water buffalo, hitched to a big bull-wheel directly connected to the shaft in the upper end of the trough. This type of apparatus for raising water is almost identical with devices seen in Japan and in the Philippines. As a rule, the water is raised but a short distance, rarely exceeding four feet.

The spacing of hills in the fields was uniform and seldom exceeded 20 centimeters between hills. In some fields the spacing was closer but the figure mentioned appeared to be the average distance. The number of bearing culms per hill was also quite uniform, the number most commonly appearing being nine, ten and eleven. As nearly as could be ascertained, the number of seedlings set in the hill would range between three and five. There were very few missing hills and but very little evidence of re-setting. The number of grains per panicle very frequently was found to be less than a hundred, but panicles were also found which exceeded that number. The kernel type most prevalent was short, broad and thick, white and non-glutinous. This type is very different from the one represented by Saigon rice appearing in the Manila market.

There were a number of awned varieties, and with regard to color of hull, as great a range from pale straw color to black as could be desired.

In the Philippines, lowland rice rarely is less than 100 centimeters in height. The prevailing short straw in the district visited was very noticeable in contrast, since many large areas covered with apparently normal plants had not a hill in which the culms were a meter long.

The writer was informed that the season's crop was the best produced in five years, and if that was the case, the general characteristics observed should be approximately normally developed.

The rice harvest begins in the north and proceeds southward by easy degrees, which is in direct contrast with the wheat harvest in North America, which begins in the south and proceeds northward.

The usual implement used in harvesting is a small sickle with a blade of 15 centimeters in length, attached at right angles to a wooden handle about 20 centimeters long. The harvester cuts a hill at a time, and, if the soil in the field is sufficiently dry, lays it flat on the ground. The usual practice is to cut several rows of hills at the same time, cutting the straw very close to the ground except the one outside row. The outside row is cut about 10 centimeters above the surface of the soil and the handful of rice plants from each hill is laid crosswise of the rows so that the panicles rest on the outside row of stubble. When the field is cut it presents a neat display of windrows, the heads all on one side, slightly raised, and the straw lying neatly and evenly. The crop is allowed to lie until it dries sufficiently so it may be threshed. At that time of the year there is little likelihood of rainfall, so the practice is quite safe.

Certain sections of this district are subject to frequent over-flows and then the harvest method is slightly changed. Instead of putting the handfuls on the ground, small sheaves are loosely bound and these suspended on wooden tripods which are set up in the field as the harvesters proceed.

In the Philippines we find it possible to plant a much larger area with a given number of laborers than can be harvested, and, for this reason, many rice farmers select an early, a medium and a late maturing variety for their fields. This practice is also found in China. The rice farmer who has land subject to over-flow, plants different varieties, so the harvest will be extended over a sufficiently long period that he may handle it with a minimum supply of equipment and with his own labor. It is nothing uncommon to see three or more varieties growing side by side in a field of one-tenth of a hectare.

The unit of land measurement is the *mow* which is equivalent to one-sixth of an acre. To be exact, the legal mow contains 7,260 square feet, but among the Chinese a mow containing but 6,600 square feet is sometimes found, and it may be imagined that the latter size is the one used when yields are computed or land is being sold.

Just as soon as the panicles are sufficiently dry so that the grains will shatter easily, threshing begins. There are three principal methods. In one case a large heavy wooden box, widely flaring and mounted on runners is taken to the field and moved from place to place as required. This box can accommodate four threshers. A large handful of the grain is grasped near the butts of the straw and the grain is removed by beating the panicles against the inside surface of the flaring box. The grain falls down towards the center of this box from which it is removed and carried to the farmer's

house in sacks or baskets. When another method is employed the loose grain is made up into large bundles and carried to the farmer's house either on the man's own back, or packed on donkeys, bullocks or carabao, or carried by boat, or wheel-barrow. The threshing floor, which is a convenient term, but misapplied in this case, is located close to the farmer's house. Sometimes the flaring box is used, but usually a small slanting table on four legs, the surface of the table consisting of wooden slats, is employed. Only one operator can work at each table and he removes the grain by beating the heads against the surface of the slatted table. The grain falls through into a box or basket, or on a mat or the earth as the case may be. Where the amount of grain to be handled is considerable, a threshing floor is made either of baked clay or of stones. The loose grain is strewed about on the floor and a large, tapering corrugated stone roller is drawn about over this material. The roller may be drawn by a water-buffalo, bullock, or by men and women. Occasionally, the roller is smooth and not tapering, but the advantage of using the tapering, corrugated roller is quite obvious. It tends to travel in a circle of a given radius for one thing. Sometimes the animal hitched to this roller is encouraged to move by ingenious means. A common scheme is to suspend a bundle of nice succulent grass barely beyond the animal's head and in his futile attempts to acquire this titbit he proceeds to move around the threshing floor in a highly satisfactory manner. Another scheme is to tie a bundle of grass on one side of the animal's head so that in trying to eat the grass he tends also to move towards the center of the floor and travel in a circle. After the grain is threshed it is spread out on mats in the open to be sundried sufficiently to prevent heating in storage.

A most unusual crop is sometimes gathered immediately after the rice is taken off. This crop consists of bricks. Where the soil is of the proper texture, the rice stubble is shaved off even with the surface of the soil and a knife is run through the soil lengthwise of the plot, cutting the soil into narrow strips of uniform widths. These strips are cut into sections and a trench dug next to the first strip. The knife is then run along underneath and the bricks carefully removed one by one and neatly laid out in the sun to dry. When the bricks are sufficiently dry to permit handling they are piled in ricks for further treatment. This is a case of making bricks without straw, but the numerous fine roots of the rice plant in the soil is a very good binder and serves the purpose admirably.

The feature of greatest interest is yield. Estimates on various fields were given, ranging from 160 to 300 catties per mow. A catty is equivalent to one and one-third pounds avoirdupois, varying slightly according to the three standard catties. These estimates are equivalent to 1,278 to 2,400 pounds per acre or 28·4 to 53·3 bushels of rough rice.

The above figures are regarded as conventional, since in the writer's opinion the yields had a wider range. Many fields did not yield as much as the indicated minimum, and several fields gave every indication of producing considerably more than the maximum. Here, as in all communities, was evidence of difference in the skill and application of methods, according to the individuals. There is not much variation in the methods employed but a great difference in the thoroughness in the application of methods. It was clearly evident that, in one case, we saw the results

produced by a good farmer, in another, those of an indifferent one, and again, the pitiful results produced by the inferior farmer.

In places was noted splendid uniformity of seed; in others the fields showed mixtures of varieties hopelessly inferior.

In the south, notably in the vicinity of Canton, the spacing of hills is more open, the distance often being as much as 40 centimeters, but more seedlings are placed in the hill.

An easy method of irrigating was noted in this district. The lands bordering on the river are apparently more recently formed. At any rate, they lie below the level of the river at high tide. Consequently, when the high tide raises the river water level, the water overflows these rice lands and remains several hours, but as the tide ebbs the water flows off again. This is the least expensive irrigation scheme on record.

In general the rice industry, at least in the regions visited, appears to be standardized to a considerable extent. Through centuries of experience it has been determined that certain lands are most suitable, certain practices reliable and given methods most productive; hence there is but slight variation when one district is compared with another.

It appears that the need is for more rice to feed the people, and this need cannot be met by any revolutionary changes in the industry. The way out lies in the elimination of poor varieties now in culture and the evolution of more productive varieties to be grown instead. That there is a great opportunity along these lines no one who is at all familiar with modern agricultural science doubts.—PHILIPPINE AGRICULTURAL REVIEW.

THE PRACTICE OF IRRIGATION.

The Director of Agriculture of Mauritius referring to this subject says:—"The most important task in practical irrigation is the laying out of the estate into one or more blocks, grading them and constructing the main channels. The essentials to bear in mind are:—

(1) to be able to give every part of the land as nearly an equal quantity of water as possible.

(2) to lay out the fields so that the irrigation will require the least possible amount of labour and so that the water in furrows will not need too constant attention.

(3) to provide for drainage.

(4) to grade canals and furrows so that as little as possible is moved."

In the case of large areas under a tank this task should be undertaken by the Irrigation Department since it is impossible for individual cultivators to tackle the matter which should be dealt with as one scheme for the whole irrigated area.

It is for the Department to prepare a contour plan from levels and divide the land into fields marking in the main canals, providing for catching waste water from the higher fields for irrigating the lower fields and for carrying away the "spent" water by drains.

C. D.

CASSAVA.

CASSAVA: ITS CULTIVATION AND UTILISATION.

The cassava plant, known also as manioc and mandioc, is a native of Brazil, where it has been cultivated from time immemorial. It is now grown in almost every part of the tropics, its tuberous roots often forming the chief source of food of the natives. In European countries the best known product of the plant is tapioca, but in recent years the starch obtained from the roots has been utilised industrially as a source of alcohol, glucose, and dextrin, and as a sizing material for yarns and fabrics. The roots themselves, after suitable preparation, and the residues of the tapioca and starch factories, are largely used as a feeding-stuff for live-stock. Within the last few years considerable interest has been taken in the crop as a source of starch in the West Indies, where the roots have long been cultivated as a foodstuff. Factories for the manufacture of cassava starch have already been erected in Jamaica, Trinidad, and elsewhere.

VARIETIES.

Cassava is a Euphorbiaceous plant belonging to the genus *Manihot*, and is thus closely related to the Ceara rubber tree (*Manihot Glaziovii*, Muel. Arg.) It is a much branched shrub which reaches a height of 12 to 16 feet when allowed to grow naturally, but under cultivation seldom exceeds 6 to 10 feet. The leaves are palmately divided, the number and shape of the lobes varying according to the variety. The flowers are unisexual and are borne in loose, spreading clusters near the ends of the shoots, the male and female flowers being produced on the same plant. The fruit is a drupaceous capsule containing three seeds, each almost as large as a castor-oil seed. The large swollen root tubers are formed in clusters at the base of the stem; they vary in size and number in the different varieties, but are usually from $1\frac{1}{2}$ to 4 feet long, and $1\frac{1}{2}$ to $2\frac{1}{2}$ inches in diameter when gathered, though they may attain a much greater size if allowed to grow for several years.

Two forms of cassava are cultivated. That most widely grown throughout the tropics is the "bitter" cassava, which yields fairly considerable quantities of hydrocyanic acid (prussic acid) from all parts of the root. The second form is the "sweet" cassava, which also yields hydrocyanic acid, but in this case it is derived mainly from the outer cortical layer or skin. They are frequently regarded as distinct species, the first being *M. utilissima*, Pohl (*Jatropha Manihot*, Linn.; *Janipha Manihot*, Kunth), and the second *M. palmata*, Muel. Arg. (*M. Aipi*, Pohl.; *M. dulcis*, Baill.; *Jatropha dulcis*, Rottb.). The two plants, however, are extremely difficult to distinguish in the field, and some botanists consider that the sweet cassava is merely a variety of the bitter form evolved in the course of time by cultivation.

PECKOLT, in an account of the cassava plants grown in Brazil, describes *M. utilissima* as a vigorous-growing plant, with dark-coloured leaves, greenish-red or reddish on the under surface, and with red or reddish-purple leaf

stalks. The stems and branches vary in colour from bright-green to blackish and frequently have a reddish tinge; they are always more or less lactescent. The tubers are large with a brown or reddish-brown epidermis of firm texture which can only be removed, as a rule, by scraping; the cortex is white and fleshy, at least 2 mm. thick or as much as 5 mm., and possesses abundant acid latex; the interior of the root is also more or less lactescent and slightly fibrous. *M. palmata*, according to the same author, is less robust, with bright green leaves, whitish or greyish on the under surface. The petioles, stems, and branches are never red, but vary from bright green to greenish-brown. The tubers are smaller than in the other species, and the epidermis is thin, yellowish or light brown, and is easily removed without scraping; the cortex, which is fleshy and white, is about 1 mm. thick, never more than 2 mm., and possesses a comparatively small quantity of very clear, neutral latex; the interior of the root contains no latex and is fibrous in the centre.

DUSS, in his FLORE DE LA MARTINIQUE, says that the stem of the sweet cassava is not angular and that the stipules are winged, whereas in the bitter cassava the stipules are rudimentary or represented by a prickle with a broad base, whilst the lobes of the leaves of the sweet cassava are somewhat larger and less tapering than those of the other plant.

Although the characters quoted above may be true of the plants grown in the countries mentioned, they do not appear to be of universal application. In Travancore, India, for example, the leaf stalks and stems of several races of sweet cassava are pink or red, and in one case bright scarlet. In Colombia, again, where all the varieties are sweet, the stems are of various colours, ranging from grey and slate to deep red. Even the toxic character of the root does not appear to be fixed. In West Africa, three varieties are stated to occur, known as white, red, and black, according to the colour of the stem. In Dahomey the roots of all three varieties can be eaten with impunity without special treatment; but two of them, the red and the white, when grown on forest soil in Nigeria, are stated to be extremely poisonous, yielding large quantities of hydrocyanic acid.

CLIMATE AND SITUATION.

Cassava is essentially a tropical plant, and can only be grown profitably in regions free from frost for at least eight months during the year. Its growth is stopped by a slight frost or even by continued cold weather. Sweet cassava is hardier than the bitter variety, and is consequently almost the only form grown in regions farthest from the equator, such as Paraguay, Southern United States, and Madagascar. In Brazil, according to PECKOLT, the bitter varieties are not cultivated below lat. 26° S., the sweet varieties extending as far as 30° S.

The plant thrives best in regions of comparatively slight rainfall and requires only 14 to 16 inches of rain per annum. In countries where the rainfall is heavy, it is necessary to select well-drained, light soils to prevent water-logging, which is fatal to the plant. Sufficient moisture is necessary to start the growth of the plant but once it has become established it will withstand prolonged and extreme drought without injury, and the crop is never a total failure through want of rain.

Although cassava is sometimes cultivated at an altitude of 2,500 to 3,000 feet the plant matures earlier and gives heavier yields in the valleys. Better results, too, are obtained in regions near the coast than inland.

Sheltered situations should be chosen for the plantation, as the stems are brittle and the plant suffers severely in strong winds.

SOIL.

The best soil for cassava is a rich, light, sandy loam. Recently cleared forest-land is preferred by the natives in most parts of the tropics, as it is rich in plant food and the crop can be grown in it continuously for several years with good yields. Many growers prefer a soil possessing a hard-pan, as in such cases the roots keep near the surface and are easier to dig. As already mentioned, the plant is drought-resisting and will give good results on very dry sandy soil on which no other foodstuff can be grown successfully. Swampy soils should be avoided and also heavy black soils excessively rich in humus; in the latter case the plant makes much top growth and the roots are small. Heavy clay soils are also unsuitable, as they give low yields and the roots are difficult to dig.

PROPAGATION AND PLANTING.

The cassava plant is always propagated commercially by means of stem cuttings. In some varieties seeds are never or rarely formed but even when available they should never be used, as the plants raised from them always give very low yields of roots. Only the middle portions of well-matured, vigorous stems should be used for propagation, the basal, woody part and the extremities of the branches being discarded.

If the climatic conditions are favourable and the land has already been prepared for planting, the cuttings may be taken from the standing crop as soon as the roots are mature; but if there is any possibility of frost, the stems must be stored carefully to prevent injury. In the latter case the stems are usually kept through the winter in whatever length they happen to come from the field, but it is best to cut them off about 6 inches above the soil and trim off the immature branches and leaves, which if left on would tend to cause fermentation and decay. The stems should be cut as late as possible to allow the roots to mature fully but before there is any chance of their being damaged by frost. They may be stored, five or six layers deep, in trenches, much as sugarcane is stored, and covered with soil, in which case the ground should be well drained and dry, as excess of moisture will cause decay. Sometimes the stems are packed upright in trenches about 18 inches deep and 3 to 4 feet wide and covered with straw or litter kept in place by a little soil; or they may be stored upright in low, wooden sheds and covered in a similar way with straw, the outer sides of the shed being well banked up with soil. Whatever method of storing is adopted, care must be taken to see that the stems are not wet when stored; they must not be left exposed to the air too long after cutting and thus allowed to become dry: the covering should be light at first to enable the excess of moisture to escape, more protection should be added as the weather becomes colder, and finally, the covering must be of such a nature as to prevent rain from penetrating to the stems.

The cuttings should not be made until they are required for planting. Their length varies in different countries; some natives use pieces 10 to 20 inches long, but the usua length on well-conducted estates is m 4 to 8 inches, each cutting possessing two or three buds. It is of course essential to use only living stems which are in good condition. Such may be distinguished by their plump appearance, fresh-looking bark, sound pith, and plump beds; any stems which appear shrivelled and are of bleached or

darkened colour, with discoloured or dried pith and shrunken buds, should be rejected. The ends of the cuttings must be cut cleanly. This may be done with a sharp machete or heavy cane knife, or by pushing the stem along a saw fixed firmly to a block, with the teeth uppermost.

The time of planting depends entirely on the climate. If the dry and wet seasons are sharply differentiated, the cuttings should be put in at the beginning of the rainy season, except where the rainfall is very heavy, when it is better to defer planting to near its close. If the rainfall is fairly evenly distributed or the land is irrigated, planting may take place at any time during the year; while in countries where there is an alternation of cold and warm seasons, it should take place as early as possible in the spring, after all chance of frost is past and when there is no fear of the soil remaining water-logged.

In many countries the cuttings are inserted two or three together, at an angle of about 45°, on mounds about 15 to 18 inches high, and sunk for about two-thirds of their length. In the West Indies they are planted in a similar way on ridges or banks. An experiment recently conducted in St. Vincent, however, indicated that better results may be obtained by planting on the level, the yield of fresh roots per acre being 17,570 lb. by the latter method as compared with 14,054 lb. when planted on banks. Whether the cuttings are planted on mounds or on the level, it is preferable to insert them singly, as if strong, healthy cuttings are employed the yield of roots will be as high as, or higher than, when two or three are planted together, and if any selection work is to be done it can be carried out more accurately. TRACY (FARMERS' BULLETIN No. 167, 1903, U. S. DEPT. AGRIC.) recommends planting the cuttings singly in furrows cut with a plough and covering them with 2 to 4 inches of soil, much as in the case of the ordinary potato.

The usual distance of planting is about 4 feet in all directions, but the actual spacing depends on the character of the soil—the distance being increased on rich soils and decreased on poorer ones—and to some extent on the vigour of the variety planted. In some countries the rows are 4 to 5 feet apart and the plants at intervals of 2 feet or 2 feet 6 inches in the rows.

In order to ensure a regular stand in the field the cuttings are sometimes sprouted in specially prepared beds and then planted out. This method is useful in the case of stems of doubtful vitality, but great care must be exercised when planting out to prevent the young shoots from being injured or broken off.—IMP. INST. BULL.

TOBACCO ASH AS FERTILIZER.

At a meeting of the Council of the Yorkshire Agricultural Society yesterday (February 3rd) at York, MR. THOMAS FAIRLEY, the Society's analyst, in a report on an analysis made by him during the year, referred to the percentage of potash in wood ashes, and said that if carefully utilized they would form a valuable source of potash in place of German deposits, from which our supplies were mainly obtained before the war. Tobacco ash was especially rich in potash, and the Society would be doing a national service by sending a circular to hotel and restaurant keepers in the country asking them to collect and save such as from their smoke rooms.

Some scheme could be devised for its collection and distribution to farmers, and if this were generally adopted the quantity of available potash salt obtainable would be very large and form a valuable asset to the county.—THE TIMES.

COTTON.

THE WAR AND THE WORLD'S COTTON SUPPLY.

Mr. John A. Todd, Professor of Economics at University College, Nottingham, contributed an important article to the April-June number of the Bulletin of the Imperial Institute on the question of the world's cotton supply which, he points out, has been critical since the beginning of the present century, for although the world's crops have nearly doubled in that period, the extraordinary expansion of the demand has all the time been pressing hard upon the increased supplies. In five out of ten seasons before the war the world's cotton consumption was actually in excess of the world's crops.

Owing to the temporary fall in prices at the beginning of the war the production of cotton all over the world was very much curtailed. But the world's surplus stocks have now been to a considerable extent worked off, and any revival of normal trade after the war coming upon the reduced supplies of raw material will, it is pointed out, almost certainly produce a severe cotton famine.

Only one thing can be done to prepare the way for meeting this difficulty when it arises, namely, to arouse interest in the development of new cotton fields within the Empire, especially in India, Egypt, and the Sudan, where the work of the British Cotton Growing Association and the International Cotton Federation has already shown the way. Russia has shown wisdom in developing her cotton fields in Turkestan and Transcaucasia, which now supply the greater part of her large native consumption of cotton. Germany, in her own sphere of influence in the Levant, has, it must be admitted, produced large results. That is a point to be remembered in the inevitable rearrangement of the Turkish Empire after the War, as is also the fact that in Mesopotamia we have a potential cotton field, which will probably rival Egypt and the Sudan in quality as well as quantity. But the greatest possibilities for an immediate increase in our cotton supplies lie in India, where great improvements both in quality and quantity have been made in recent years.—Tropical Life.

GIANT RUNNER BEAN.

Mr. Norman Ross of the Chandypore Tea Co., Cachar, India, on 30th January wrote with regard to the Giant Runner Bean:—". . . . . I have great pleasure in testifying to the excellent qualities of the Giant Runner Bean. It commenced fruiting at 6 feet high at the end of November and has been doing so ever since—this notwithstanding I have left 10-12 pods on each for seed. It is very tender and of most excellent flavour. After they had been fruiting about a month I gave them a good sprinkling of mustard oil cake and forked it in—this made them make a lot of fresh growth which fruited at every joint. In my opinion it is the best runner bean I have ever seen."

JAMES J. NOCK.

SOILS AND MANURES.

DYNAMITING SOILS.

W. R. WHITE.

Experiments conducted to determine the influence of dynamiting on (1) the physical condition of soils, (2) soil moisture and drainage, (3) newly planted fruit trees, (4) mature trees, (5) field crops, and (6) insects in the soil are reported. The soils used were the Hagerstown clay loam and Volusia silt loam.

From these experiments it is stated that "while the results.....can not be taken as conclusive for all conditions, yet they may indicate that the useful application of dynamite as a soil improver is limited. Its usefulness may depend largely upon local conditions. No definite benefits were derived from its use in either orchard or field crops. What it might do under different conditions, or over longer periods, is yet to be determined. One pond was drained and the other was not. Its usefulness in shooting an open ditch, blasting boulders, and blowing stumps can not be questioned. It may be very useful in draining land where no outlet can be found for a tile drain. How permanent its effect may be is not known. As to destroying insects (ants), it has not proved to be of any use. It is probably safe to conclude that the application of dynamite as a soil improver is greatly limited and that it would always be advisable to try it out in a small way before investing much money in its use."—Expt. Stn. Record.

RELATION OF PLANT TO SOIL.

The first two lectures by Dr. E. J. Russel, Director of the Rothamsted Experiment Station, was delivered before the Royal Institute on February 29th, on the subject of "The Plant and the Soil-Nature's Cycle."

Setting out with familiar observation that the upper layer of the soil alone is well suited for plant growth, it was shown that this distinction did not always exist. When the soil was first laid down, it was all like the subsoil, but something has happened to bring about the change. Two methods present themselves by which the problem can be attacked; on the one hand some subsoil may be exposed to the weather, and the experiment carried out in such shape that the transformation into surface soil can be closely observed; or, on the other hand, careful analysis can be made of the surface and subsoils with a view to discovering wherein lies the difference between them. The first is called the observational method, and is familiar to all gardeners and field workers: the other is the analytical method, and necessitates laboratory work. In practice, both methods have to be adopted. Strictly speaking, a third method—the synthetic method—is desirable in addition: this involves reconstruction of the soil on the basis of information acquired by the first two methods: but progress has not yet gone far enough for this.

Whenever subsoil is left exposed to the air it begins to cover itself with vegetation. The first plants that come up draw some of their food material from the soil, and they build up their leaf and stem tissues partly out of this and partly out of the carbon-dioxide in the air. The process is in one important respect very much like rolling a ball up a hill—energy has to be put into it; and in this case the energy comes from the sunshine. But neither energy nor matter is ever destroyed in Nature, and, in consequence, when the plants die and their leaves and stems become mingled with the soil, they add to its mineral matter both organic matter and energy.

Direct experiment shows that this addition of plant residues is beneficial to plant growth. Other evidence all tends the same way, and the general conclusion is that the difference between the surface and the subsoil lies largely in the presence of the residues left by the generations of plants that have lived and died there. The problem now is to find why the plant residues are so beneficial.

This is as far as observation will take us; it is now necessary to bring the problem into the laboratory, in order to investigate it further.

The plant residues consist mainly of four elements: carbon and oxygen in large proportions; hydrogen and nitrogen in smaller proportions. In addition, there are lesser quantities of phosphorus, calcium, magnesium, potassium and other substances. The chief reaction in the soil is soon found to be an oxidation: oxygen is absorbed in great quantities, and carbon-dioxide is given out in approximate equal volume. The carbohydrates of the plant disappear very rapidly: some of the cellulose takes longer, and gives rise to the black humus familiar to all gardeners. The nitrogen appears as nitrate. This is not quite what one would expect. In the decomposition of protein as it has been studied in the laboratory—and a prodigious amount of work has been done on the subject—the result is always a remarkable variety of acid, known as amino-acids. Under the action of putrefactive bacteria, the decomposition is carried a stage further, and ammonia and other bases are produced, which are largely responsible for the very strong odour of decaying substances—but nitrates are not found by the processes of the chemist. At first sight, therefore, it looks as if the process of the chemist was quite distinct from that of the soil, but closer study shows that this is not so. All the substances isolated in the chemist's decomposition can be found represented in the soil, and, what is still more to the point, if a trace of choloroform or toluene is added to soil no nitrate is formed, but ammonia accumulates instead. When a trace of untreated soil is added, the process starts again, and nitrate is found as usual. Thus, it appears that ammonia is the precursor of nitrates, and is itself preceded by the amino-acids of the chemist. The difference between the laboratory decomposition and the soil decomposition is simply that the latter is carried several stages further: up to the point reached in the laboratory the two processes appear to be substantially the same. Thus Nature operates in the same way, whether in the laboratory or the field: the differences are only in the lengths to which things go.

This decomposition is absolutely indispensable to the plant: the initial products—the proteins—are useless for plant nutrition; the intermediate products are not much good; the ammonia is considerably better, while the final stage—the nitrate—is the best of all.

During this decomposition energy stored up by the plant during its lifetime is run down, so that there is a transformation both of material and of energy. We are accustomed to think of Nature as somewhat prodigal: the vast number of seeds produced by certain plants, the hosts of spores produced by fungi to ensure survival, all indicate this. But in the soil Nature is in a far more economical mood. The energy and material are not wanted: they go to support a vast population of the most varied kind, ranging from the microscopic bacteria to the earth worm. All these depend on plant residues for their food and their energy. But theirs is no case of taking all and giving nothing in return. Their work is nothing less than the production of food for the plant: preparing new plant food out of old plant residues.

Thus we have a great cycle going on in the soil: dead plant residues mingle with it, and give life to countless micro-organisms, which in turn convert them into food for a new generation of plants.

It is necessary to set some limits to the enquiry, and so we restrict ourselves to the production of nitrates. This process is the work of a great number of organisms, some of which carry out the first stages, and others the later stages. It resembles the process of making munitions, in that the first stages can be brought about by a large variety of workers, while later stages are much more specialised, and can be effected only by one or two special workers. Indeed, in the eighteenth century, Nature's process of manufacturing nitrates was actually under the Ministry of Munitions of the time. Great wars were going on which consumed vast quantities of nitrate: there were no Chilean deposits available, and no artificial nitrates: all that was wanted had to be made by this soil process. Nitrate beds were made up, much like cucumber borders; they were kept moistened by liquid manure, etc., and in course of time great quantities of nitrates were formed, which were afterwards washed out.

The process is not free from waste: starting with 100 parts of nitrogen as protein, one never recovers 100 parts of nitrogen as nitrate: there is always a loss. But the fault does not appear to be with the special organisms that carry out the last stages of the process, for at least 96 per cent. of the ammoniacal nitrogen is recovered as nitrate. It is not clear that it lies with the organisms producing ammonia: at any rate, they can work without loss. The probability is that the loss arises from some of the nitrate that has been actually formed.

However it arises, this loss, as well as the leaching out of nitrate by rain, would in natural conditions bring the stock of soil nitrogen to a very low level, if there was no counter-balancing process, and for the last fifty years chemists and bacteriologists have been searching the soil very thoroughly to find out how these gains are brought about. Two sources are now known: the organisms associated with clovers and other leguminosæ and the free living nitrogen-fixing organisms. They differ very much in appearance and mode of life, but for their work they both require a source of energy; for the process of nitrogen fixation, like that of plant growth, is like rolling a stone up a hill. In place of sunlight, these organisms get their energy from the combustion of sugar.

It must not be supposed, however, that the organisms bringing about these changes are the only ones in the soil, or that they lead their lives quite

independently of the rest of the soil population. Indeed, they could hardly do that in any case, for there is only a limited store of food and energy, and whatever is not helping them is hindering them. Numerous experiments show that there is some factor, neither food, air, water, nor temperature, which is operating to keep down these numbers. As it is put out of action by heating to 55·6°C., or by traces of volatile antiseptics, and can be re-introduced by adding a little untreated soil, it is presumably biological, and the evidence shows that it consists in part at least of certain soil amœbæ: it is quite possible, of course, that other forms are involved as well. But whatever the detrimental organisms are, they impede the work of the organisms producing plant food in the soil. Fortunately, they are put out of action more easily than the useful organisms, so that we get the apparent paradox that any process fatal to life (but not too fatal) proves ultimately beneficial to the soil life, while any process beneficial to life proves ultimately harmful. Long frost, drought, and heat, therefore, benefit the useful makers of plant food, while prolonged warmth, moisture, and treatment with organic manures lead to deterioration, or to "sickness," as the practical man puts it.—GARDENERS' CHRONICLE.

INFLUENCE OF BACTERIA ON GREEN MANURES.

L. G. LIPMAN, A. W. BLAIR, H. C. McLEAN, AND L. K. WILKINS.

This is an account of a continuation of experiments previously described (E.S.R., 32, p. 514), the results of which indicate "that the bacteria conveyed in small quantities of manure do have a beneficial effect in the decomposition of the green manure crops. When the green manure crop is a legume, the additional nitrogen thus secured tends to obscure the effects of the manure. The legume is more effective in increasing the yield and also in maintaining the nitrogen supply of the soil than the non-legume, and there is good ground for believing that the nitrogen in the former is more available than in the latter."—EXPT. STN. REC.

GREEN MANURING.

Bulletin No. 56 issued by the Indian Department of Agriculture treats of green manuring (A. C. DOBBS). It consists of a survey of the work done in India.

The practical side of the subject is dealt with reference to plantation crops as well as to the cultivation of rice, tobacco, etc.

The most important recent development of green manuring in India has been in connection with the rice crop.

Experience has shown that the most economical way of growing the main crop of rice is usually to sow the seed in a seed bed and to transplant the seedlings into puddled land when sufficient water has accumulated. This method is almost universal in India, and is being rapidly adopted in the few backward tracts where it is not already prevalent.

Experiments in some of the principal rice-growing tracts of India have proved that the interval between the first monsoon showers and the transplanting of the seedlings can be profitably utilized for the growth of a green manure crop. Under favourable conditions the seed of the green manure crop may be sown at the end of the preceding cold weather and the young crop will survive the hot weather and be ready to take full advantage of the early part of the monsoon.

THE RESPECTIVE VALUES OF ORGANIC AND INORGANIC MANURES.

H. E. P. HODSOLL.

(Continued from Page 247.)

It will therefore be seen from these experiments that organics fully hold their own against the corresponding mineral unit. Further, they are not all exhausted in one year, but leave behind valuable residues for following years. This has been clearly proved at Rothamsted, where the effect of dung has actually been detected forty years after its application. This is not so with mineral ammoniacal manures, which both the Rothamsted and Woburn experiments show are practically exhausted in one year.

It is clear, therefore, that we cannot dismiss the question on solubility only, for, as we have seen, organic manures even supplied in the raw state not only give better results but leave the soil richer instead of poorer, and had the soluble organic manures that are now obtainable been used in the experiments doubtless their superiority would have been even more marked.

This conclusion, of course, will not surprise practical men. We all know the value of dung, crushed hoof, meat and bone stuffs, etc., and that we cannot get good crops by the use of minerals alone, or put heart into a poor soil by the application of superphosphate and nitrate. The point is, why cannot we? Wherein lies the undoubted superiority of the organic manures for these purposes.

I think we can best answer these questions by considering the action in the soil of the two classes of manures from three points of view, viz. the mechanical, chemical, and biological.

1. *Mechanical.*—Let us first examine their effect on the mechanical or physical condition of the soil. Now all organic substances contain humus: that is, they leave behind, after they have decayed in the soil, that valuable residue that we have learnt to associate with the use of farmyard manure or leaf-mould, etc.; and this humus, which more than any other ingredient is always tending to oxidize and diminish in the soil, has very marked effect on its working.

Humus opens a clay soil by loosely binding together the finer particles to which its plastic nature is due. These particles are so fine as to assume when extracted from the soil an almost gelatinous nature, and when they are spread out, or "deflocculated" throughout the soil they make the whole into a sticky unworkable mass, giving the clay what is known as its colloid property. It is this property that enables the potter so to work his clay that he can mould it at will, and upon which the brick-maker relies when he puddles his brick-earth before moulding his bricks.

All practical men are painfully aware of this characteristic of a heavy soil when they try to work it after rain before it is sufficiently dry, and their aim in cultivation is to counteract it as far as possible and so to manage their heavy soils that they may crumble down into a fine and workable condition.

Humus greatly assists in this endeavour by collecting together or "flocculating" these fine particles; perhaps the simplest instance of this action of humus is that afforded when a piece of old grass land naturally rich in humus is ploughed up, especially if the soil be heavy. After the winter it will crumble readily, so as to harrow down to a mellow seed-bed while on a neighbouring piece of the same soil that has been arable for some time a number of large unyielding clods will probably be noticed.

Again, on a light soil, humus, by acting in a contrary direction, has an equally beneficial effect; in this case it loosely binds together the coarser particles, imparting to the soil more of a spongy or retentive nature.

This mechanical effect of humus leads to the following advantages in soils well supplied with this important ingredient:—

The land retains much heat otherwise lost, and, being warmer, the crops consequently ripen earlier.

The land dries more quickly, yet retains its moisture better in drought.

The superfluous moisture from storms and heavy showers is held as by a sponge and passes downwards gradually; thus all wash is avoided; the water retaining power of a soil well supplied with humus is 20 per cent. greater than that possessed by a mineralized soil.

In dry weather the land cools sooner and more dew is precipitated. The air passing over humus-fed soil is cooler and moister than the air passing over a mineralized soil; the rainfall will therefore be greater. If the soil all over the country were richer in humus the rainfall would be more uniform, as in countries covered with forests.

The soil, being more open, is better ærated, and consequently more plant food is set free.

Much manurial matter that would otherwise leach away is retained.

The plants are healthier; a soil deficient in humus is always more likely to support disease: clover sickness and finger-and-toe are never so prevalent on soils showing a high humic content.

Of this fact the Indian coffee planters are well aware; as long as their soils were well stored with the vegetable matter of the primeval forests which previously occupied the site of their plantations there was very little disease among the plants; as soon as the humus became exhausted diseases increased, but have again been reduced by adding the top soil from the neighbouring forest lands.

The importance of a good tilth and a good seed-bed cannot be over-estimated; in fact, if the weather conditions are adverse to the start of a crop, the eventual yield will often depend more on the physical condition of the seed-bed than upon any other factor. No better proof of this fact could be given than that afforded by Table I. from the Rothamsted experiments given above. As has been previously pointed out, there are always more roots on the rape cake plot than on the others, showing that the conditions are far better for the young plants; in fact, the physical condition of the soil where only minerals are used has become so bad that only in favourable seasons is a good plant obtained and on three occasions the sowings have completely failed, whereas the rape cake plot always starts regularly.

Against these many advantages of the humus-containing organic manures we have to place the distinctly bad effect that most mineral manures are known to have on the physical condition of the soil.

Probably nitrate of soda is the worst, owing to the fact that the residue it leaves behind in the soil—caustic soda—deflocculates the clay, which consequently becomes puddled.

Sulphate of ammonia and superphosphate leave an acid residue which is harmful to plant life, and still more so to bacterial activity.

It is true that those minerals which leave lime as a residue in the soil, such as basic slag and nitrolim, are not subject in the same way to this objection, but it is undoubtedly true to say that one of the great advantages of organics over inorganics is that the former materially improve the texture of the soil by increasing the supply of humus, and thus enable a good seed-bed to be obtained and a good tilth maintained, whereas the latter, generally speaking, have an opposite effect.

2. *Chemical.*—Under this heading I want to consider the chemical form in which the food materials exist in the two classes of manures, and to show how this affects the feeding and consequent growth of the plant.

The outstanding feature of organics from a chemical point of view is that the food materials they contain are not all present in one form, but exist in a large number of different and complicated chemical compounds; and it follows that these compounds, being differently constituted, vary greatly in their availability as plant food, and therefore come into use (chiefly by the aid of bacteria, as we shall see later) gradually and continuously.

On the other hand, the minerals are mostly definite chemical salts of known and comparatively simple composition; it follows, therefore, that the conditions—of temperature, moisture, etc.—that render one of their food units available for the plant will have the same effect on the rest, so that the whole becomes available for the plant at the same time. This not only means that while this process is taking place the plant has too much food, but, being unable to take it all the remainder is washed out of the soil and lost, and is not there when the plant is ready to take in further supplies. This objection, of course, particularly applies to the highly soluble nitrogenous manures, nitrate of soda and sulphate of ammonia.

It has been abundantly proved that, for good quality in the product, manures that come steadily into use throughout the season are required, rather than the very active ones that induce a sudden rush of growth.

Further, the gradual availability of organics builds up a reserve of food material in the soil, so that eventually the land becomes stored with manurial residues.

It must be remembered that the soil is more rapidly exhausted of ammonia than of phosphate or potash, so it is particularly necessary that ammonia should be obtained from an organic source. That this fact is realised by horticulturists is proved by the demand for organic ammoniacal manures, the higher price paid for these per unit over the minerals being greater in proportion than that paid for the organic as against the inorganic units of phosphates.

Hall states in one of his well-known works: "The hop grower, for instance, won't get the quality he wants by substituting a mixture of super and sulphate for the guanos or organic manures he has been accustomed to use;" and again:

"It is only a lasting manure which accumulates in the soil to build up 'high conditions,' the state of affairs which prevails when reserves of manure in the soil are steadily and continuously passing into the available condition in sufficient amount for the need of the crop, a state of affairs which results in healthy growth of good quality."

It is evident, therefore, that the slow and gradual solubility and lasting nature of organics is of the utmost importance, and is another reason for their superiority over the minerals, which, as I have shown, do not possess these valuable qualities.—Jour. of the Royal Hort. Soc.

INFLUENCE OF SOIL ON THE AVAILABILITY OF MANURES.

J. G. LIPMAN, A. W. BLAIR, H. C. McLEAN, and L. K. WILKINS.

This is an account of a continuation during 1914 of experiments begun in 1911.

It was found that sodium nitrate and dried blood when used on mixtures of sand and shale soil, varying in proportion from 10 to 90 per cent. sand, gave higher yields of dry matter and nitrogen in the first crop than when used with loam soil alone or sand alone. With the first crop sodium nitrate invariably gave higher yields than dried blood. "The average recovery of nitrogen with nitrate of soda for the first crop was 60·52 and with dried blood 43·92 per cent. The highest recovery with nitrate of soda was 71·17 per cent. where the mixture contained 70 per cent. of sand, and the highest recovery for dried blood was 56·3 per cent. with 80 per cent. sand. Taking 100 as the availability of the nitrate of soda for this crop, the availability of the dried blood was 72·07 ..... In four out of ten series no nitrate nitrogen was recovered in the second crop, and, with one exception, the recoveries from the other six were low. The average residual recovery from dried blood for all series was 11·05 per cent."

With reference to the total recoveries of nitrogen, the sodium nitrate stood first in all cases, except where sand alone was used. In this respect the dried blood showed an availability of 85·66 when sodium nitrate is taken at 100.

These results are taken to indicate that a marked residual effect can not be expected from a moderate application of sodium nitrate, but that some residual effect may be expected from dried blood in nearly all cases. Mixing sand with heavy soils was found to permit better æration and drainage and to result in a more complete utilization of the soil organic matter.—Expt. Stn. Rec.

DRYING THE SOIL.

For the planting or sowing of all crops it is essential that the surface of the soil should be dry. To attempt to crop wet land would cause a greater failure than waiting several weeks. The smaller the seeds or the plants, the drier should be the soil. A light soil will often be fit for sowing after a day's sunshine and wind, but in the case of a heavy soil measures must be taken

for hastening the drying by loosening the soil to a depth of three inches with a hoe or a drag. In doing this, undue treading on the soil must be avoided. On a small, narrow plot it is possible to loosen the greater part of the surface by the use of a long handled hoe or drag, while the operator stands on the path. When it is impossible to reach all the plot by this means, the treading on the soil can be considerably reduced by taking long strides while working, and moving the feet as little as possible.

It may be necessary to loosen the soil thus two or three times, the last time with a long-handled wooden rake. The soil will be quite ready for raking down fine and drilling for seeds when it does not cling to the boots or the tools. The seeds can only be properly covered when the soil is made so fine that the lumps are approximately no larger than a walnut. If the weather seems likely to be fine throughout the day it is an advantage to drill the ground early in the morning and to sow in the afternoon. This affords a further opportunity of getting the soil, which is to cover the seeds, quite dry.—THE TIMES.

POT EXPERIMENTS ON THE AVAILABILITY OF NITROGEN IN MANURES.

J. G. LIPMAN, A. W. BLAIR, H. C. McLEAN, AND L. K. WILKINS.

The object of these experiments, which supplement plot experiments previously noted (E. S. R., 31, p. 124), was to determine the availability of a number of organic and inorganic nitrogenous fertilizers as compared with that of sodium nitrate. In the first four experiments pots containing 20 lb. of sand were used.

A comparison of sodium nitrate, ammonium sulphate, tankage, and cotton-seed meal, when added to barley in sand, in amounts equivalent to 616 mg. of nitrogen per pot, showed that the highest average yield of dry matter was with ammonium sulphate and the next highest with cotton-seed meal, while the highest content of nitrogen in the dry matter was obtained with sodium nitrate and the next highest with ammonium sulphate. The amounts of dry matter of a second crop grown in the same pots without further fertilizer treatment were much less than those of the first crop in all cases, as was also the nitrogen content, except where cotton-seed meal was used. The total recovery of nitrogen was greatest with sodium nitrate and the next highest with ammonium sulphate. These results are taken to indicate that a comparison of sodium nitrate with equivalent amounts of materials not so rapidly available is not fair if the application is small or moderate and if only one crop is grown.

A comparison of sodium nitrate, alfalfa meal, green rye, dry blood, and cotton-seed meal, when added to buckwheat in sand at the rate of 462 mg. of nitrogen per pot, showed that sodium nitrate gave the highest average yield and dried blood was second. A residual crop of barley was largest on the nitrate pots, but all the recoveries were low.

A comparison of sodium nitrate alone and in combination with vegetable and animal organic matter and with the organic matter alone, when added to buckwheat in sand in amounts equivalent to 616 mg. of nitrogen per pot, showed that the residual effects from the use of sodium nitrate were small if the first

crop developed normally, but were considerably increased where an excessive amount of the nitrate depressed the yield of the first crop. The residual effects from the use of organic nitrogenous materials were greater than those from nitrate of soda, but were small when considered from the standpoint of the amount of nitrogen that apparently remains in the soil after the removal of the first crop. Nitrogen applied in the form of nitrate of soda and organic matter, half the nitrogen from one and half from the other, gave a higher yield of dry matter and a higher recovery of nitrogen than nitrogen which is all in the form of organic matter.

A comparison of sodium nitrate with ammonium sulphate, ammonium nitrate, calcium cyanamide, calcium nitrate, dried blood, green rye, and alfalfa meal, when added to buckwheat in sand in amounts equivalent to 308 mg. per pot, showed that the highest average yield was obtained with calcium nitrate and the next highest with ammonium nitrate. The lowest yield obtained with calcium cyanamide. In general, the percentage of nitrogen in the crop receiving organic materials was lower than in that receiving minerals. The highest recovery of nitrogen was with sodium nitrate and the next highest with calcium nitrate.

In pot experiments with buckwheat on a loam soil, using green manures, sodium nitrate, and ground limestone, the purpose of which was to determine the effects of ground limestone in the decomposition of organic matter, it was found that in every instance the average yield of dry matter was higher with ground limestone than without, whether used with green manure alone or with green manure and sodium nitrate. The percentage of nitrogen in the crop was invariably higher where sodium nitrate was used with the green crop, either with or without lime. These results are taken to indicate that the limestone aided the decomposition of the organic matter and increased the availability of the nitrogen.

In a final experiment with barley on a mixture of sand and loam to determine the effect of vegetable matter in the soil on the germination of seed and on the growth of the crop and the effect of ground limestone on the decomposition of vegetable matter, it was found that the ground limestone had a beneficial influence on the decomposition of the organic matter and in making the nitrogen of this available. No effect of the vegetable matter was observed on germination.—Expt. Stn. Rec.

THE NITROGEN PROBLEM IN ARID SOILS.

C. B. LIPMAN

Amongst the various problems relating to arid soils, especially in California, recent investigations and certain observations in actual practice have brought out the importance of the nitrogen problem.

From the various data collected the writer draws the following provisional conclusions having a practical bearing:

(1) The introduction and maintenance of a good stock of organic matter in the form of green manure or dung should be practised on all soils deficient in nitrogen or organic matter.

(2) The nitrogenous manures applied to these soils should be high-class organic manures such as steam-bone flour, cotton-seed meal, sewage residues, and in other cases sulphate of ammonia.

(3) It is necessary to prevent heating of the soil, excessive evaporation and oxidation of organic matter, by means of a mulch of straw or dung. This is one of the most important practices in soil management in Californian gardens and vineyards deficient in nitrogen and organic matter.—BULL. OF INT. INST. OF AGRIC.

RESULTS OF THIRTY YEARS OF LIMING.

W. H. McINTIRE

Field experiments with burnt lime with and without manure, ground limestone, and gypsum on a silty clay loam soil are reported, the purpose being to ascertain (1) to what extent and depth applied lime descends into the subsoil, (2) the amount of lime conserved and lost by cropping and leaching, and (3) the effect of lime upon the chemical composition of the soil. The crops grown were corn, oats, wheat, and grass. Burnt lime and ground limestone were applied at the rate of 4,000 lb. per acre, gypsum at the rate of 320 lb. per acre and manure at the rate of 6 tons per acre.

Where lime was applied alone increased crop yields were obtained only with ground limestone. Burnt lime decreased the organic matter of the soil when applied alone and decreased humus accumulation when applied with manure. Calcium sulphate and ground limestone increased the organic matter. Each form of lime increased the nitrogen content of the soil, gypsum-limestone, and burnt lime being effective in the order given. The addition of lime to manure increased crop yields and the nitrogen content of the soil. More lime was removed from the surface in the case of ground limestone and when lime was used with manure than when burnt lime was used alone. Manure induced more thorough dissemination of lime throughout the entire 21 in. of soil, at the same time conserving it.

Gypsum decreased the calcium carbonate content of the soil, but increased the total calcium oxide content. The highest occurrence of inorganic carbon dioxide was due to ground limestone, burnt lime with manure being second, and burnt lime alone third. In general the carbon dioxide content decreased with the depth, as did also the lime content. Approximately 36·8 per cent. of the lime applied with manure, 39·7 per cent. of the burnt lime applied, and 40·3 per cent. of calcium oxide of the limestone, treatment were found to exist as carbonates. Approximately 24·3 per cent. 15·9 per cent. and 22·5 per cent. of the calcium oxide applied to three different plots occurred in forms other than carbonates.

The magnesium percentage decreased in every instance, the loss being greatest in the first 7 in. and least in the last 7 in. Every case of lime treatment resulted in a decreased total potash content. No correlation between residual lime and residual potash was found. Phosphorus was conserved where lime was applied as burnt lime, both with and without manure. The effect of ground limestone was not so marked upon the phosphorus conservation as was that of burnt lime, while a loss occurred in the plots treated with gypsum.—EXPT. STN. REC.

NITRIFYING ORGANISMS IN THE SOIL.

E. J. RUSSELL.

The story of the nitrifying organisms is an old one, but it bears re-telling. Only two organisms are known that can change ammonia to nitrite, and only one that can change nitrite to nitrate. All three are extremely small, and they are unique in that they build up their substance out of carbon dioxide, obtaining the requisite energy from the oxidation of the ammonia, and not from sunlight, as plants do. They do not require organic matter for food or for energy supply—again a distinction from other micro-organisms; indeed many organic compounds are harmful to them. This property is so marked in culture solutions that all organic matter was long supposed to be harmful, but this is now known to be incorrect. Nitrifaction will take place in presence of organic matter; it is known to go on during sewage purification, and it takes place regularly on the other side of a dungheap. But there are two conditions which are highly detrimental to the nitrifying organisms, viz. acidity and lack of air. Provided these are avoided, the organisms will tolerate soil organic matter.

Running alongside of this decomposition is another. The amount of nitrate formed is never as great as one expects from the nitrogen in the protein, and the deficit is attributed to a loss of gaseous nitrogen. We have, therefore, two possibilities: the protein may change to nitrate or it may change to nitrogen.

Now the evolution of gaseous nitrogen is of no value whatsoever to the farmer or the gardener: on the contrary, it represents a dead loss, because the nitrogen is only dissipated. It is difficult to exaggerate the seriousness of this loss to the intense cultivator. One of our plots annually receives the liberal but by no means excessive dressing of fourteen tons dung to the acre, containing 200 lb. of nitrogen. Of this about 50 lb. is recovered in the crop and about 25 lb. remains in the soil; some also gets away in the drainage water. But about one half of the nitrogen cannot be accounted for, and presumably it goes off as gas; at any rate the cultivator gets no benefit from it.

It is impossible to form a precise estimate of the losses of nitrogen in a market garden, but the conditions all favour high losses; still more do they do so in glasshouses where crops like cucumbers are being grown.

The market gardener is compelled to manure heavily in order to secure heavy crops, and his loss of nitrogen simply represents the extra price that always has to be paid whenever production is forced beyond a certain level. But just as the engineer has learnt how to increase the efficiency of an engine, so the cultivator has to learn how to increase the efficiency of his production processes. This cannot be accomplished until the nature of the soil-changes is better understood and the cause of the loss of nitrogen has been revealed. The action in the soil is too slow to allow of easy investigation; it is marked enough to cause serious loss over an acre in a year, but not in the small amount of material one uses in the laboratory and the limited time available for an investigation.

Tables showing Losses of Nitrogen from Cultivated Soils, Broadbank Wheat Field, 47 years, 1865-1912.

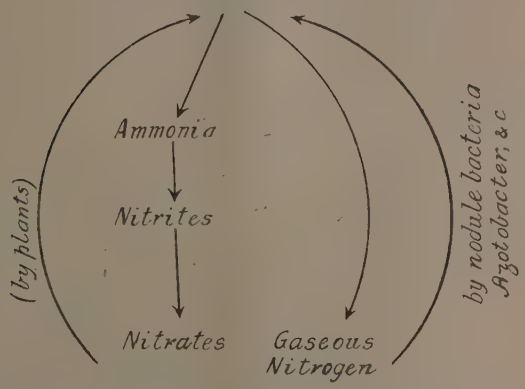
	Rich Soil (2) lb. to the acre.		Poor Soil (3) lb. to the acre.	
N. in Soil, 1865 ...	175 %	4340	150 %	2720
N. added in manure rain (5 lb) seed (2 lb) ...		9730		330
N. expected in 1912		14070		3050
N. found in 1912 ...	245 %	5730	103 %	2510
Loss from Soil ...		8340		540
N. in crops ...		2550		750
Balance being dead loss		5790		210
Annual dead loss ...		123		5

When a difficulty of this sort arises the method adopted is to study parallel cases where the action is more pronounced. Two of these are being studied in some detail: the loss from a sewage bed and the loss from a manure-heap. Sewage presents a particularly interesting case, because here the loss is actually utilized as a means of sewage disposal, and the sewage chemist tries to encourage it just as strenuously as the agricultural chemist is trying to stop it. Indeed the situation is not altogether devoid of humour, for the community on the one hand spends many thousands of pounds in destroying nitrogen compounds in its sewage works, and on the other spends many thousands of pounds in purchasing nitrogen compounds for its soil. It was to find some way of bridging this difficulty that the Hon. Rupert Guinness came forward and enabled us to secure at Rothamsted the services of Mr. E. H. Richards, late of the Sewage Commission investigations, to make a systematic study of these losses. At Rothamsted we have selected the manure-heap because of its special agricultural and horticultural importance; in France, Minitz and Laine took the sewage-bed. For a long time it was uncertain whether the gaseous nitrogen arose direct from the proteins by a process analogous to combustion or whether it was formed by decomposition of the nitrates. The problem is not yet solved, but the evidence is steadily accumulating against the combustion hypothesis, and so far as it goes it indicates that the nitrogen passes safely through the ammonia stage but gets lost afterwards. If this turns out to be correct, an interesting method of reducing the loss, if not of preventing it altogether, will become possible. It is obvious that if the ammonia (or the nitrate into which it is converted) is absorbed by the plant it cannot give rise to gaseous nitrogen in the soil, and therefore the loss will be eliminated by arranging the conditions so as to facilitate absorption by the plant. It has been shown in agricultural practice that absorption of nitrate is greatly facilitated by properly balancing the manures, and we may hope for a good deal by adopting the same plan in horticulture. At present horticultural practice is to say the least, indiscriminate, and there is considerable scope for improvement.

Again, however, a cycle is operating: opposed to all this loss of nitrogen are two sets of processes by which the losses are made good and nitrogen is fixed in the soil.

THE NITROGEN CYCLE IN THE SOIL.

Complex Nitrogen Compounds.



The growth of leguminous crops, as is well known, adds to the stores of nitrogen in the soil through the combined operations of the plant and the organisms present in the root nodules. Leguminous plants occur in nearly all natural vegetation and their activity is very wide-spread, constituting by far the most considerable source of added nitrogen.

The second source of increased nitrogen is to be found in the activities of certain free-living bacteria which can fix nitrogen on their own account and do not require the co-operation of a living plant. At least two of some importance are known: Clostridium, which was the first to be discovered, is an anærobic organism, i.e. it works in absence of air, but it can form a close association with ærobic organisms so that it can work in presence of air, and certainly its action is not precluded in the soil. The second, Azotobacter, is more potent and has proved far more attractive to investigators. It works very vigorously in crude cultures, but is less active in pure cultures; it used to be supposed to lose its potency on cultivation, but recent work has shown that it remains active in a suitable medium.

Both Clostridium and Azotobacter build up complex nitrogen compounds from gaseous nitrogen, a process that requires energy; and both draw the necessary energy from the oxidation of the plant residues—presumably the carbohydrates—in the soil. It is reasonable to suppose that both organisms are active in the soil, but no rigid proof has ever been given. The fact that land laid down to grass tends to gain nitrogen has been adduced in proof, but it is not really satisfactory.

Table showing gain in Nitrogen in land laid down to Grass in 1856 and mown annually. Rothamsted.

Per cent. of Nitrogen in top 9 inches.	1856 ·152	1879 ·205	1888 ·235	1912. ·338

On such land the ammonia and nitrates are assimilated more rapidly and completely than in arable land, and there is therefore less liability to loss of

nitrogen; further, leguminous herbage almost invariably grows for part if not for the whole of the year, making additions to the nitrogen supply. There is nothing to preclude the action of the free-living nitrogen fixers, but nothing to prove it.

These accumulated nitrogen compounds, whether built up by organisms associated with the Leguminosæ or by the free-living forms, all break down by the processes just indicated and pass into nitrates with or without loss of gaseous nitrogen, according to the conditions.

From the standpoint of plant nutrition we may look upon the formation of nitrates in the soil as being the most important of all the processes, and for long it was regarded as probably the only one with which the agricultural chemist need concern himself.—JOUR. OF THE ROYAL HORT. SOC.

THE EFFECT OF CLIMATE ON SOIL FORMATION.

J. W. LEATHER.

There are two soils in India whose mode of formation is still unexplained, viz. the laterite and the Regur or Black Cotton Soil. These two soils are very distinct in several characteristics. The Regur is black or dark brown in colour: when wetted it expands to an unusual degree and on drying large fissures form in it; it retains unusually large amounts of water; it is practically devoid of stones except where near rock formations and frequently contains 5 to 10 per cent. of calcium carbonate, though the proportion of this constituent sometimes falls to less than 1 per cent. It rests on various rock formations, partly on the Deccan trap, on the metamorphic rock in Southern India and on the Cuddapah quartzites.

Laterite when first exposed is soft and light coloured, but rapidly hardens on exposure, and after breaking down to soil is red; it frequently or generally contains gravel, including limonite, but otherwise the soil has no special physical features. Like the Regur soil, however, it rests on various formations, the association being remarkably alike in the two cases.

At one place in the neighbourhood of a bed of Regur it is possible to find the rock taking the dark colour of Regur and at another not far away the same rock is weathering to red soil. Thus the formation of these two soils from the same rock cannot therefore be simply attributed to either weather or climate.

HOLLAND has previously shown that the formation of laterite soil is more easily accounted for on biological than on chemical grounds. Possibly also the case of the Regur soil may be an instance of bacterial activity.—BULL. INT. INST. OF AGRIC.

SERICULTURE

IN SOUTH INDIA.

T. V. RAMAKRISHNA AIYAR, B.A., F.E.S., F.Z.S.

(*Continued from page 256.*)

The Diseases of the South Indian Silkworm.—Similar to the silkworms of other countries the South Indian insect is also subject to numerous diseases. These go by various vernacular names. In Kollegal the chief ones known are (1). *Sarpikke.* During the later stages of the worm the insect passes its excretion in the form of a *sara* or chain and most of the worms that do so die before spinning. This disease is called sarpikke. (2). *Ginnu.* This disease is denoted by a swelling at the back during the later stages of the worm and gradual death. (3). *Kenchu* is a turning into red of the worm after the fourth moult; the worm remains inactive and shrinks. In Berigai also the rearers have some diseases such as 'Lāl' or red disease, swelling disease, etc., but the definite characters of each are not known. Other local names of some of these diseases are 'Chappay', 'Hālhula' (white worm), etc. Most of the diseases appear during the later stages in the life of the worm. It is almost certain that many of these diseases prevailing amongst silkworms in Southern India must be identical with those met with in other silk rearing countries, since experts like WOOD-MASON and MUKERJI have found out that the silkworm diseases in Bengal are the same as those of Europe. From a rough comparison of the characteristics of the local diseases it appears that what is called 'Sarapikke' is Flacherie, *Ginnu*, Grasseri and *Kenchu*, Pebrine. MUKERJI is of opinion that the silkworms in Southern India are chiefly subject to Flacheric and that they are more or less free from Pebrine. The writer is, however, led to believe that Pebrine also prevails in Southern India since he has had the opinion of experts on diseased worms forwarded for examination. There is very little doubt that a good percentage of worms reared in Southern India succumb to these diseases and it is to this cause that we must attribute the gradual decline of this industry to a very great extent. Since writing this a good deal of evidence has been gathered to prove the existence of Pebrine in Southern India.

The food of the South Indian Silkworm : Mulberry.—The mulberry plant which is the food of the South Indian silkworm is known locally by different vernacular names. In Tamil it is known as '*Thippal naval Chedi*,' in Telugu as '*Kamblichettu*,' in Canarese as '*Ippunirle*' and in Hindi (Berigai) as *shālhōoth jad*. Unlike other parts of the world, where for silkworms the mulberry plants are allowed to grow into standard trees, here in India the plant is propagated chiefly as a bush. Although the method of growing trees is said to be better in many ways, the bush system appears to be followed perhaps to suit the *polyvoltine races* of silkworms raised in India. Numerous local

varieties of the plant are known among ryots under different vernacular synonyms which are very often confusing and misleading. It is highly probable that all these are only cultivated varieties of the one species, *Morus, alba* variety *indica*, which according to DUTHIE is the species chiefly grown all over India to feed silkworms. The selection and preparation of the soil, manuring and the various other details in connection with the cultivation of the mulberry in the two localities, Kollegal and Berigai, are so different that it would be better to treat each separately. In both places the plants are propagated from cuttings. In Kollegal the mulberry grower and the silkworm rearer are in the majority of cases different individuals. In almost all villages of the taluk where silkworms are reared owners of land generally set apart a portion for growing mulberry and later on sell the foliage to silkworm rearers. At so much for the area according to the quality of the crop the owner of the mulberry crop allows a silkworm rearer to pick leaves for one season, with the condition that the amount settled should be paid before the picking is finished: or the contract is often for paying the amount in weekly instalments in advance. The soil generally selected by the Kollegal ryot is neither of the best kind nor of the worst quality: dry lands of indifferent quality are commonly selected. The best lands are always reserved for food crops. Both red and black soils are made use of, though the opinion is that the plant grown in red sandy loams gives foliage of excellent quality. A sixth of the arable area in this taluk is under mulberry—the area for the fasli 1319=1910-11 being 10,928 acres. Of the four or five varieties of mulberry known in the taluk such as 'Raja gaddi,' 'Butha gaddi,' 'Kari gaddi,' Ennerangan gaddi,' etc., only two are popular, viz., *Butha gaddi* and *Ennerangan gaddi*, and of these the latter is extensively cultivated; but there is a lot of confusion between these, and even in the fields they are often found mixed up. The land selected is prepared for the crop during the summer months and the planting is done soon after the first rains. The preliminary operations consist of ploughing the land three to six times at intervals and mixing up manure with the soil during the last ploughing. The manure generally consists of farmyard and village refuse. As many cartloads of manure are applied as one could afford or spare for this crop after reserving the required quantity for his food crop fields. Generally from 3 or 4 to 10 or 12 cartloads are applied to mulberry lands for each acre. Soon after the first rains planting is done. One man with a plough makes furrows and in these furrows men and women make holes at distances of 3 or 4 feet apart each way and put in two or three cuttings in each hole. Mature mulberry stalks for making cuttings are generally got gratis from old plantations where the annual pruning of plants goes on at this time. From 4 to 6 good headloads of mature stalks are used up by the Kollegal cultivator to plant up one acre with cuttings. The stalks are cut into pieces 8 or 9 inches long and two or three are put in each hole. The majority of the mulberry growers in Kollegal put the cuttings flat in the holes and cover them completely with soil like sugarcane cuttings. I am told that the ordinary method of planting is resorted to only when it is done at other seasons and in gardens where there are good facilities for irrigation. In this taluk the mulberry crop is raised purely as a rain-fed crop. When the rain fails for a few days after planting, the cuttings are given a watering or two by water being carried in pots.

POULTRY.

POULTRY KEEPING IN CEYLON.

BY "BLACK ORPINGTON."

Some years ago I kept poultry with rather more than average success in Ceylon, since when I have been away in different parts of the world, returning about the commencement of the war. I was agreeably surprised to find the poultry industry had apparently (I say apparently with an ulterior motive) made great strides; there were more experts in evidence, a club was well supported, which had its own journal. Now, after looking round carefully for 18 months, my own personal opinion is that the local poultry industry is little better (if any) than it ever was. The "man in the street") (or rather, on the estate), "keeps" poultry in every sense of the word—the poultry do not help to keep him. The "experts" are, after all, very few and far between, and are mostly in the business for what they can get out of it. In these strenuous days, they need not necessarily be blamed for this, but their point-of-view is apparently that to assist the poultry industry all they need do is to sell settings of eggs and birds at quite a good price to the tyro—and when the tyro has killed his birds by injudicious management, well, he can buy some more! How often do we see the local expert's name or initials at the foot of an instructive poultry article, either in the newspapers or the Club's journal? Never! The Ceylon Poultry Club Magazine consists monthly of 12 pages of assorted advertisements and clippings from Home papers, and is but of little use locally. The clippings from Home papers are useful—but not to Ceylon. For instance, we read in the December 1915 Number that "We have reached the season of fog, damp, rain, and cold. And likewise the time when eggs are bringing splendid prices." The Editor, who is a man of vast experience and knowledge, obviously took this (and many other items) from "Poultry," quite regardless of the fact that December-January are usually reasonably dry in Ceylon, and that the average price of fresh eggs here hardly varies at all! Surely there are members of the Poultry Club with sufficient knowledge and time to write useful articles of general interest, applicable to Ceylon conditions, by the help of which the beginner can make his poultry a source of profit and pleasure?

But my purpose is rather to point out that just now poultry-keeping is a national necessity throughout the Empire. Every household should possess from 20 to 100 fowls as time and space allows, and having them, they should learn to make them pay. Not perhaps to return a profit of so much per cent. on outlay, but to enable the householder to supply himself and family with sufficient eggs and birds for eating, to the end that he may rely less on imported luxuries.

My second reason is to supply some of the hints most useful to those who "keep" fowls.

Where most people go wrong is in feeding. Nearly all give too much, some give too little, and practically every amateur gives the wrong kind of

food. To take the first. Many people have told me that 30 or 40 hens give them only two or three eggs per day, and they are "fed up." On enquiring how they feed them, the reply is invariably, "Oh, I let them out to scratch most of the day, and give them plenty of paddy." Now there is no egg-forming material in paddy; if you shut a hen up so that she gets no other food, and feed her on paddy only, she will lay no eggs at all, and these 30 or 40 hens that are let out daily manage to lay a few, because they get at other food—and some of those eggs are probably laid in places that only the hen and the garden cooly know of, so down goes your average yield some more.

Firstly, give your hens as good an enclosure as you can manage. Waste land on which there is low scrub which can be partially cleared is as good as anything, and a plot of about 12 to 15 yards square will comfortably accommodate 15 fowls and require very little digging and liming. If fowls are crowded, the soil gets sour, and requires lime well dug into it two or three times per year. The same number of fowls require a well-ventilated house four feet square, larger if convenient. House should be wooden, tarred, with earth floor, well hammered down, with perches not more than 12 inches above the ground. A better house would be that with mud walls and wooden roof, but the wooden house has the advantage of being removable to fresh ground if required. Do not use tagrum for house or roof, as it causes tremendous changes in temperature between coldest and hottest hours of the day and night.

FOOD.

Make up your mind to cut out practically all paddy, giving it only as a change now and again. Indian corn give only in cold, wet weather, and then not too freely, as it causes over-fatness. A fat hen can *not* lay eggs.

For the morning feed give a hot mash of poultry meal, in which may be included with advantage, every other day, one-quarter part good bran. Put the bran in a bucket first, sealed with boiling water, and add the meal, mixing to the consistency of a crumbly paste. In this mash include all the useful kitchen scraps, minced or chopped fine, boiled cabbage leaves, potato peels, etc. Let the fowls have this one hour after they are let out in the morning, and give them as much as they will eat readily, but no more.

The mid-day meal should be very light, and can be omitted entirely if the fowls have ground containing good green food or piles of litter such as dead leaves, in which they find food. In any case, give only a few handfuls (3 handfuls to a dozen fowls) of grain, well scattered.

For the evening meal wheat or good oats are the best possible, and the birds should have as much as they will eat one hour before roosting. Really good heavy oats are difficult to get in Ceylon, and very expensive, but no harm will result if wheat is fed only for the evening meal. Give paddy one or two evenings a week if you wish, as it reduces the food bill. On wet, cold evenings a reasonably good plan is to start with wheat, then paddy, and after the paddy give as much as the fowls require to fill up of Indian corn. They will not have had as much of the latter as will put on fat, while sufficient will be given to warm them up nicely for the night.

There is no golden rule as to quantity per head. The best maxim is to never give full grown fowls all they will eat except at the evening meal; after all other meals they should be ready to scratch for what can be found.

Green food is essential for fowls, and if none is growing in their enclosure, it must be supplied. Lettuce is excellent raw, but cabbage leaves and other coarse vegetables should be boiled.

Clean, cool water should be at hand. See that the water vessels are kept clean, in a shady place, and replenished two or three times a day. It is an excellent scheme to put a few crystals of permanganate of potash in the water, as this acts as a prevention to illness. Another useful dodge is to put one ounce Epsom salts to the morning food of each dozen fowls one day per week, whether they want it or not.

If you have space on which to let your fowls out of their usual enclosure, it is well to do so daily. Let them out at 3·30 p.m., and they will come in for their evening feed at 5. This gives them a change of ground, an interest in life in searching for food, and somewhat cuts down the corn bill. If fowls are to be kept successfully, you must aim at keeping them active and interested. A lot of birds that move listlessly around the place waiting for the next meal time will invariably be found on enquiry to be a dead loss to their owner.

Do not let the fowls out until 3·30 as by then they will have finished laying for the day.

The above indicates somewhat briefly the general lines on which I have kept fowls for some 16 years. Probably I have possessed something over 5,000 birds in that time. I do not believe twenty of them have died of illness, and every year of the sixteen has shown a handsome balance of profit.—

TIMES OF CEYLON.

THE SECRET OF SUCCESS.

The good gardener is he who has a beautiful garden, even if he grows only the easiest plant in it. For it is never easy to have a beautiful garden. You cannot do it if you want to excel others in growing difficult plants, or if you are eager to follow the latest fashion in garden design, or if you care more for the names of plants than the plants themselves. That wonderful gift which some gardeners seem to have for growing anything is no magic; it comes from the love of plants. They think of their plants more than they think of themselves. And that other gift for making a garden beautiful is no magic either. It comes of loving the garden as well as the plants. If your garden is to be well designed, it must be a part of your home to you and not merely a plot for growing plants in. You must regard it as a place to live in and not as a place to show to other horticulturists. Those who would be good gardeners should learn to enjoy their gardens and not merely other people's praise of them.—THE TIMES.

AGRICULTURAL EDUCATION

SCHOOL OF TROPICAL AGRICULTURE.

TEST EXAMINATION.

The following are the questions and results of the first Intermediate Test Examination of the School of Tropical Agriculture held at Peradeniya on Monday 27th March and the 3 days following.

The Examination consisted of 8 written tests, made up as follows:—

(a) four major papers with a time limit of 1½ hours and a maximum of 150 marks, each paper consisting of 5 questions.

(b) four minor papers with a time limit of 1 hour and a maximum of 100 marks, each paper consisting of 4 questions.

The major papers were set on the following subjects:—Economic Products, Chemistry, the Soil, the Plant.

The minor papers were:—The Animal, Co-operation, Crop Pests, Agricultural Engineering.

The maximum of the examination was 1,000 marks.

ECONOMIC PRODUCTS.

1.—What do you understand by the term "fruit?" How should choice varieties of fruit trees be propagated?

2.—Edible fruits may be divided into two main sections. Describe these briefly and give examples.

3.—Mention what in your opinion are the 3 best and most suitable fruits for each of the following localities and state briefly what you know about each kind:—

A. Dry region, as Jaffna or Anuradhapura
B. Wet region, as Kegalle or Ratnapura
C. Up-country, as Hatton or Nuwara Eliya.

4.—What is the best variety of Pineapple grown in Ceylon? State the points in its favour and how you can distinguish it from others.

5.—Write a short descriptive note on each of the following spices:—

A. Cinnamon
B. Cardamom
C. Cloves.

REPORT OF EXAMINER:—

42 per cent. of the students passed in this paper.

(Sgd.) H. F. MACMILLAN.

THE ANIMAL.

1.—Into what divisions is the animal body divided for the study of its anatomy?

2.—Name and compare the different kinds of diathrodial (movable) joints.

3.—Make a diagram of the alimentary canal, indicating thereon the different parts beginning with the mouth.

4.—Describe the functions of the Reticulum (or first stomach) and state its functions.

ENGINEERING.

1.—Describe a Gunter's chain. What errors is the surveyor liable to make in using this chain?

2.—How is a chain survey executed in easy open country and why? Illustrate your answer by a plan.

3.—How would you find the area of a triangle, having been given its three sides?

How would you modify this in the case of equilateral isosceles, and right-angled triangles?

4.—(a) How do you construct a right angle with the help of a chain alone?

(b) How many sq. links, sq. chains, sq. yards make an acre?

(c) Define :—base line, off set, surveyor's cross.

(d) What is meant by drawing a plan to scale? Illustrate your answer with a diagram.

REPORT OF EXAMINER :—

The papers were corrected from the standpoint of matter and not language. The students require some practice in answering question papers. In many cases their language does not express what they mean.

(Sgd.) W. P. A. COOKE.

CO-OPERATION.

1—What were the first four systems of Co-operative Credit Societies? Describe them.

2.—When and how were Co-operative Credit Societies recognised by the Government in Ceylon?

3.—Give a short description of the constitution and management of a society as far as you understand them from the Ordinance.

4.—Name three advantages conferred on these societies by the passing of the Ordinance.

REPORT OF EXAMINER :—

Only six students failed to obtain pass marks.

(Sgd.) N. WICKRAMARATNE.

CHEMISTRY.

(Diagrams illustrating answers will enhance their value.)

1.—Describe two synthetic and two analytic methods of determining the composition of water. What Gas Laws are illustrated by the reactions of steam?

2.—Give some example of the importance of water in the economy of nature.

3.—Give a list of ten of the more important chemical elements, tabulating the following details regarding each (1) Atomic weight. (2) Symbol. (3) Character. (4) Two well known compounds.

4.—Define:—Acid, Alkali, Salt, Base, Indicator. Give three reactions of acids with bases (with equations) showing the products of the reaction.

Carbonic acid is a di-basic acid. Explain this statement and give the structural formula of carbonic acid.

5.—Explain briefly the process used in the manufacture of sulphuric acid.

"Sulphur and its compounds are of great agricultural importance." Substantiate this statement, giving the uses of sulphur and two of its compounds.

REPORT OF THE EXAMINER:—

28 candidates (50%) obtained pass marks. The examination has revealed one very noticeable feature: those who came to the school course with no knowledge of Chemistry have, with one exception, done better on the whole

than those who have had previous laboratory experience. The first place too was gained by a student who had done no previous work in the subject. I think this fact may be explained partly on the ground that those who were new to it worked more eagerly on a fresh subject, partly perhaps because those who had done earlier work in Chemistry had vainly deluded themselves that they already knew all that it might be necessary for them to know, and so put in less work on the subject than was needed.

The results of this examination have also disclosed the hard workers among the students.

Among the 28 failures are 6 who have been interrupted during the course by illness.

(Sgd.) St. L. H. De ZYLVA.

CROP-PESTS.

1.—Describe briefly the metamorphosis of Insects (a) Complete Metamorphosis (b) Incomplete Metamorphosis.

Which orders of Insects belong to each section?

2a. Give the distinctions by which one may determine whether a given insect is a beetle or a bug.

b. What kind of insecticides are mainly used in destroying bug-pests and why are they used for this purpose instead of other kinds?

3a. Give a list of the orders of biting and chewing insects.

b. Give six main ways in which these insects work.

4a. Give the main divisions of the Order Orthoptera. Which of these are pests and which are not?

b. Give the characteristics of the Order Hymenoptera.

Report of the Examiner:—

Five candidates obtained over 70% marks. 17 candidates (30%) failed to obtain pass marks.

(Sgd.) G. M. HENRY.

SOILS.

1.—Describe the action of water in the formation of soil.

2.—Make a general classification of *rocks*, giving examples.

3.—Define Soil and Subsoil, and explain the terms texture, structure, specific heat, and hygroscopic power as applied to soils.

4.—What are "alkali" soils and how are they formed? Name some plants found growing in them and mention their peculiarities.

5.—Give directions for taking a soil sample for analysis.

Report of the Examiner:—

15 candidates (27%) failed to obtain pass marks.

18 candidates (30%) obtained over 50% marks.

(Sgd.) G. E. J. HULUGALLE.

THE PLANT.

(N.B.—Freely illustrate your answers with diagrams.)

1.—Describe, giving examples, the various kinds of roots with which you are acquainted.

2.—How is starch produced, and how is it transferred and stored away in plants?

3.—Write brief notes on (a) the structure, (b) formation, and (c) uses of.—(1) stomata, (2) root-hairs, (3) laticiferous vessels, (4) oil glands, (5) resin passages.

4.—Explain the terms hypogyny, perigyny and epigyny. Which condition do you consider most advantageous, and why?

5.—Classify and describe six fruits that you have studied.

REPORT OF THE EXAMINER :—

The table shows that 50% of the students who stood the examination have satisfied the examiner.

Considering that on "The Plant" the students had 2 or 3 times the number of lectures they have had on other subjects, it is not surprising to get 50% of failures. I have hopes of the first 17 failed candidates doing better in the next inter-examinations.

At present the mass of facts studied and noted have got the better of them. The answers plainly show an incoherent and confused grasp of facts.

It is hoped that the lectures in the next season according as they recapitulate and amplify facts already studied will within their application to agriculture give them the power which is the desideratum of such studies.

With a few exceptions, all questions were attempted. Most students got mixed up in their answers to the last question.

Questions 1 and 4 were answered best.

Answers to question 3 were disappointing and brought home very forcibly to the examiner the necessity for some sort of microscopic work that will help to catch and fix what are now rather hazy ideas.

Question 2 was not answered so well as the examiner expected that it would have been.

(Sgd.) HENRY L. VAN BUUREN.

RESULTS OF EXAMINATIONS.

List of names of students who passed in all subjects :—

Order.	Names.	Percentage of Marks.	Order.	Names.	Percentage of Marks.
1	Mendis, M. S.	72	8	de Silva, R. E.	62
2	Jackson, J.	71		Orr, C. E. M.	62
3	Kurien, E. K.	66	10	Pieris, H. C.	59
	Pereira, B. A.	66	11	Perera, V. G.	57
5	Ludowyk, J. H.	63		Bibile, C. W.	57
	Kapuwatte, P. B.	63	13	Kotani, T.	55
	Dias, A. E.	63		Van Reyk, B. E.	55

REPORT ON EXAMINATIONS.

Fourteen candidates passed in all 8 papers: eight candidates in 7 papers only; nine in 6 only; seven in 5 only; three in 4 only; ten in 3 only; one in 2 only and four in 1 only.

No student failed in every paper of the examination.

Eleven students were absent from the whole examination.

Of the 56 students who sat for the examination, 39 passed on the aggregate, making 70 passes per cent. approximately. These results are gratifying.

The Pass List (aggregate) contains the names of 14 students who passed in all the 8 papers, and of 25 students who failed in one or more papers but passed on the aggregate.

(Sgd.) ST. L. H. DE ZYLVA,
Registrar, School of Tropical Agriculture.

Peradeniya, April 14th, 1916

CO-OPERATION.

ADVANTAGES OF CO-OPERATIVE CREDIT SOCIETIES.

The majority of the inhabitants of a village are cultivators; the rest are traders, carpenters, weavers, smiths, potters, or follow other occupations. They all require capital or ready cash to carry on their work. The farmer needs it for buying manures, draft-cattle, ploughs and for paying the labourers engaged in watering his tobacco and other crops or for sinking a well. Money is required by the trader to buy his stock in trade; by the carpenter to purchase materials and tools; by the weaver to buy yarn, etc; by a smith to procure metal wherewith to manufacture various articles, and so on. No one will gainsay the fact that money is the prime necessity for making any progress in his business and that without it very little can be accomplished. It is not every one in a village who possesses sufficient ready money for meeting his requirements. Indeed there are very few who are able to meet their outlay from their own resources. One point is clear, that those who have no ready money must borrow from lenders of money. It is no discredit to borrow money since most of the transactions in the world are carried on with borrowed capital. But what one should consider before he borrows is what interest he has to pay. As a rule the poor man has to pay a higher rate of interest than the rich man. The fact is the poorer the man the higher the rate of interest he has to pay. Why? Because the poor man has no facilities for approaching the money market, while the man in good circumstances has; because the poor man is given no credit as he has no visible security while the man of means gets it because he can give security and therefore enjoys the confidence of the money market. A poor villager is unable to obtain a loan from a big bank, while the man of property enjoys this privilege. The poor man has, however, one medium through which to approach the money market, and he has one asset he can utilize as security. This asset is his good character and the medium is a Co-operative Credit Society. This is just where a Co-operative Credit Society can come to the poor man's help. A Co-operative Credit Society registered under the Ordinance is a means through which the poor man can find his capital on as easy terms as the rich man is able to procure his from a big bank.

So it will be seen in the first place that Co-operative Credit Societies enable the poor man to obtain a loan on low interest. The society can raise loans and its members can get loans from the society. The affairs of the society are in their hands and they can fix the rate of interest chargeable to members. If the rate of interest charged by the money lenders in a village is 24 per cent. per annum (that is two cents per rupee per mensem) the society's rate may be fixed at 9 or 12 per cent. per annum (that is $\frac{3}{4}$ of a cent or one cent per rupee per mensem.)

The interest paid to the society belongs to the members themselves and any profit made by the society is theirs also.

A society is not only a medium for obtaining loans, but also a medium for banking one's savings. Therefore the object of a village society is two-fold: (1) to provide a means by which money can be borrowed at a lower rate of interest than that now charged by professional money lenders and (2) to teach the villager how he can save some money for himself.

Every villager can save something out of his crop or earnings and those savings, no matter whether it is a few cents or a few rupees, may be deposited with the society in the same way that one may deposit his money in a Post Office Savings Bank and he will receive interest for such deposits. The society may pay interest on such deposits at the rate of 2 or 4 per cent. per annum. Money deposited may be lent out at a higher rate of interest to members thereby bringing more profit to the society. So a society in a village provides the members with a sort of bank from which to borrow money and also a safe place in which to deposit money in the same way that a town bank serves the richer classes. It does more than that. It encourages members to be economical and inculcates thrift. Only persons of good character are eligible as members. As the society is managed by themselves, members learn business habits and receive a training in the control of money and in the keeping of accounts.

The office bearers and the Committee will see that the society's work is carried on according to regulations. The society's accounts are audited annually by a Government official. A Co-operative Society like other business co-operation is not required to pay any fee to Government for its registration and the instruments executed by or on behalf of a society are exempted from stamp fees and registration fees. Every facility is given by Government for carrying on the work of a society. This is not all, for Government is prepared to lend money on very low interest, (say 4 or $4\frac{1}{2}$ per cent. per annum) to the approved societies to be repaid in small instalments extending over to a number of years.

A society should have a reserve fund to meet unforeseen losses. This is formed by placing to its credit a small proportion of the profits of the society.

As all the office bearers work gratuitously, there is no expenditure on the working of a society excepting such minor expenses as stationery, which may be met from profits.

Benefits and advantages accruing from a Co-operative Credit Society cannot be described in a small leaflet like this. Such a society can be adapted to meet various purposes and may term as credit societies, supply societies, societies for the disposal of produce, cattle insurance societies, etc.

A word about the money lender and the wealthier class of people or leaders may be said here. They may entertain objections to joining a society of this nature and ask what benefits they will derive from it. Now to begin with, it may be stated that every code of morality teaches us to help the poor, and this thought should weigh with the man of means. But at the same time they must not consider that these are charitable institutions. On the contrary they are established on a sound business basis. Another point to remember is if the better class people do not take the opportunity of joining these societies at first they will be left behind and those who succeed in launching

a society, will get on with their work without them. Men of position and money lenders can help societies in two ways. Firstly they may give their personal assistance by advising and leading them in the proper path and secondly by depositing their money on interest in these societies. Thereby the society is benefited, the members are benefited and they themselves are not losers. They get interest for their money and a good name for their assistance. If not, when the villager can borrow money at low interest from the society he will not come to the money lender to borrow on high rate and so the money lender will lose his customer.

These societies are not new societies though new to Ceylon. They have been established in every European state. There are thousands of societies in India too.

According to 1913-14 figures there were in the Madras Presidency alone (just on the other side of the sea) 1,333 societies with 105,537 members and a working capital of Rs. 12,320,186. The total number of societies in India in the same year was 16,158 and the number of members stood at 777,604. The working capital was Rs. 80,190,779·00. This will show what progress they have made in India during the last 10 years as these were first established in India in the year 1904.

In Ceylon we have so far 55 societies: out of these nearly 50 are in working order. The membership of these is 4,812 and the paid-up capital is nearly Rs. 25,000/-. Ours is a new movement and when the people come to understand the benefits and advantages of the societies, and when they learn their working and begin to have confidence in it, we hope to have a society in almost every village, and to find every villager a member of his own society. Thus we shall be helping out the cultivator from his present helpless state, save him from the usurious money lender and make him a happy and contented man.

Any information on the working of a society can be obtained from the Registrar of Co-operative Credit Societies or the Secretary, Board of Control, Co-operative Credit Societies, Department of Agriculture, Peradeniya.

N. WICKRAMARATNE,
Secretary, Board of Control,
Co-operative Credit Societies.

Peradeniya, 31st March, 1916.

CO-OPERATIVE CREDIT SOCIETIES AND MANURE FOR PADDY.

Very few are aware that a large quantity of bone manure is used by the ordinary paddy cultivators in the low country villages for their paddy crop. In the usual way the villager would either purchase his bone manure for cash from the village boutique keeper by paying 20 per cent. or so more than the cost price or buy on credit to give paddy in kind after the harvesting of the crop which when sold would produce money valuing 50 per cent. or so more than the cost price of manure.

Since last year a commencement has been made by some of the Co-operative Credit Societies to utilize their worth in the co-operative purchase of bone manures and sale among their members with some satisfactory profit to societies and great convenience to members. Twelve of the societies have received during "Yala" and "Maha" seasons in 1915, and "Yala" season in 1916, eighty one tons and four hundredweight of bone manure costing Rs. 8,449·17. One society has purchased manures for coconuts and another society for tea, indicating the interest taken by the villager in the manuring of other crops than the paddy, which was once considered the only crop manured by him.

N. W.

METHODS OF PLANTING POTATOES.

There are various methods of planting, according to the nature of the soil. In a light soil, which is easily worked, the general practice is to make holes with a stout setting peg, about 6 inches deep and 2 inches to 3 inches in diameter, and after carefully dropping in the sprouted tubers to push soil in with the feet. Another method, suited for a heavy soil is to draw deep furrows with a hoe and to push the tubers in the bottom, covering them with the feet or a rake. Yet another plan, which is suitable for a heavy soil which has been dug in the autumn, is to fork the soil loosely and plant as this work proceeds. This is an excellent plan, as it leaves the soil quite loose over the tubers—a condition especially suited to potatoes. The plan is to fork the soil to a depth of 6 inches to 8 inches until there is space for a row to be planted. The line is set and the soil drawn from it with a spade to ensure the tubers being planted at a uniform depth of 6 inches. Forking is continued after the tubers are placed, these being covered as the work proceeds. When there is again sufficient ground dug another row is planted, and the method is continued throughout the plot.

For early varieties the rows may be 20 inches apart, and the tubers 9 inches apart in each row. Good early varieties are May Queen, Midlothian Early, Sir John Llewelyn, and Ninety-fold. The potato is a useful crop for planting on waste land which had recently been cleared.—THE TIMES.

THE CEYLON

STATEMENT OF RECEIPTS AND PAYMENTS FOR

RECEIPTS.	Rs.	Cts.	Rs.	Cts.
To Cash in Hand of Secretary 31st Dec., 1914.			30	
,, Stamps in Hand, 31st Dec. 1914.			58	49
,, Members' Subscriptions.				
Local Subscriptions for 1911	8			
do 1912	32			
do 1913	233			
do 1914	908	50		
do 1915	5417	90		
do 1916	282			
,, Foreign Subscriptions	7708	58	14589	98
,, Government Grant (including one Quarterly Instalment for 1914)			36250	
,, Interest			179	36
Forward			51107	83

PAYMENTS.	Rs.	Cts.	Rs.	Cts.
By Balance at National Bank			334	84
,, General Expenditure:—				
Organising Vice-President	3000			
Assistant Editor	999	96		
Proof Reader	240			
Clerks and Peons	5414	60		
Agricultural Instructors	5601	72		
Stationery	411	77		
Postage and Telegrams	2057	95		
Office Furniture	40	13		
Bank Charges and Commission	100	60		
Miscellaneous Petty Expenses	2117	20		
Printing	186	09		
Auditors' Fee for 1914	200			
Year Book	1023	14	21393	16
Carried Forward			21728	

We certify that we have prepared this account of Receipts and Payments from the books

Colombo, 11th April, 1916.

AGRICULTURAL SOCIETY.

THE TWELVE MONTHS ENDED 31st DECEMBER, 1915

PAYMENTS.			Rs.	Cts.	Rs.	Cts.
BROUGHT FORWARD					21728	
BY TRAVELLING EXPENSES						
Secretary and Staff			2296	94		
Agricultural Instructors			3966	69		
Special Officers			361	81		
Organising Vice-President and Staff ...			173	33	6798	77
,, TROPICAL AGRICULTURIST & JOURNAL OF C. A. S.						
Printing English Magazine			6522	60		
,, Tamil Edition			200			
			6722	60		
Less Received for Advertisements ...			3100	48		
			3622	12		
Cost of Singhalese Magazine						
Editor's Fee	470 ...					
Printing, and other charges ...	932 ...					
	1402 ...					
Less Subscriptions and Advertisements	952	30	449	70	4071	82
,, AGRICULTURAL SHOW EXPENSES:—						
Cost of medals					9	75
,, EXPERIMENTAL GARDENS:—						
Paddy and Tissa Grass			32	65		
Bandaragama 200/-, Kegalle 184/30 ...			384	30		
Balangoda 195/-, Badulla 45/			240			
Jaffna 37/50 Tobacco Plot 37/50			75			
Nikaweratiya and Hettipola 111/75, and Ambalantota 172/75			284	50		
Mediwake 100/-			100		1116	45
,, APICULTURE					1	50
,, SEED STORE AT GOVERNMENT STOCK GARDEN:—						
Coolies' Wages and Miscellaneous Expenses					319	33
,, SERICULTURE EXPERIMENTAL FARM:—						
Sundry Expenses					195	
,, AGRICULTURAL IMPLEMENTS					46	55
,, SEED SUPPLIES:—						
Excess Purchases over Sales						
	Purchases.	Sales.				
Vegetable Seeds	343·29	403·03				
Paddy	184·67	34·00				
Grafted Plants	956·27	1095·23				
Tephrosia Candida	45·22	36·97				
Lucerne	25·50	36·77				
Potatoes	441·36	240·60				
Coffee	3·50	2·20				
Mangosteens	15	10·44				
Sundries, Including Betel Cuttings Fern Balls, etc.	221·59	210·23				
	2236·40	2069·47				
Excess Purchases		166·93			166	93
,, STOCK OF STAMPS					23	91
,, BALANCE AT NATIONAL BANK					16629	82
				Rs.	51107	83

of the Society and that to the best of our belief it is correct.

FORD, RHODES, THORNTON & Co.,
Chartered Accountants.

GENERAL.

To The Editor, Tropical Agriculturist.

Dear Sir,

I enclose an extract from the Daily Mail of 13 December, 1915, about the Soya Bean*

In 1909-1910 I tried to get the villagers of Dumbara to grow the lima bean and bring in for sale to the Kandy market. It grew very well in Dumbara and when I left Ceylon in April 1910 there seemed to be some prospect of a successful result to my efforts in this direction. But I suppose since then interest in the subject has evaporated and probably nothing is now doing.

I should be glad to hear of any progress that is being made with either the Soya or Lima.

Yours truly
J. P. LEWIS
(Late G. A., C. P.)

Quisisana, Walton-by-Clevedon,
Somerset.
21st February, 1916.

LUCERNE.

J. H. GRISDALE.

Lucerne is another name for Alfalfa. It is a leguminous plant just as are peas, beans and clovers. Plants of this family are all rich in protein.

Alfalfa is perennial, that is a plant capable of living many years under favourable conditions. It is upright and branching in its habit of growth, the mature plants varying in height from 1 to 3½ feet. Its leaves are three parted, the leaflets being narrowly oblong in outline. Its flowers are purple, and are arranged like those of the vetch rather than as those of the clovers. It sometimes produces seeds in Canada in small quantities.

The stem is rather woody, which characteristic develops very rapidly as maturity approaches. The leaves are attached by slender stems which become very brittle when the somewhat matured plant is dried.

The roots penetrate deeply into the soil. It has a tap root which has been known to go to great depths where the subsoil was permeable.

The rootlets bear nodules which enable it to secure its nitrogen supply from the air. The young plant consists of a number of low branches springing from a simple basal stalk at the crown of the root. These branches ascend directly above ground and form a compact tuft. On the old plant, however, certain of the more robust stems elongate underground and become new branch-producing stocks.

In this way the simple stock or rhizome becomes two or many-headed.

* Not reproduced.

SOILS.

As just stated, alfalfa is a deep-rooted plant, hence in considering soil suitable for this crop the character of the subsoil must always be of primary consideration. Two qualities are absolutely necessary in the subsoil for an alfalfa crop to succeed. It must be well drained to a depth of at least 2 feet, and it must be possible of penetration by the roots of the alfalfa plant to a similar or greater depth.

Any field likely to be under water, or the soil saturated with water at any time for more than thirty-six hours at a time, is quite unsuitable for alfalfa. Any field with a hard-pan subsoil within two feet of the surface will prove unsatisfactory for alfalfa.

The most suitable soil conditions for securing a good stand of plants and securing good and continuous crops afterwards, are a light sandy loam in good heart over a deep loose alluvial subsoil.

A subsoil rich in plant food is of course very valuable, but, while fertility in the subsoil is important, permeability is still more to be sought after. A sandy subsoil while not in itself so rich in plant food is likely to give much better results than a clayey subsoil under a similar surface soil. Upon the fertility and physical condition of the surface soil more than upon any other factors depends the success of the first year. The success or failure of later years depends in a great measure upon the subsoil.

SOIL PREPARATION.

To insure a good stand three conditions are necessary in the land selected :—

1. Freedom from weeds.
2. Excellent physical condition or tilth.
3. Abundance of plant food.

Freedom from weeds may be secured by sowing immediately after a hoed crop as potatoes, corn or roots, or by sowing after a complete or a partial summer fallow. Clover sod, stubble, or even old meadow ploughed shallow in August, rolled and cultivated at frequent intervals during September, and receiving proper treatment in October, may be expected to give good results. In October it should be ploughed again with a subsoiler attached to the plough, or ploughed with two ploughs, one without a mould board following in the track of the other, and stirring the subsoil as much as possible, or cultivated lengthwise, crosswise and angling with a strong stiff-toothed cultivator, to be followed by a double mould board plough, leaving the whole field in ridges about 7 inches high and 22 inches apart.

Such treatment insures a seed bed permeable to early roots, fairly rich in plant food, and in excellent physical condition. The latter condition is insured by the retention of the humus or decayed vegetable matter (roots, fallen leaves, etc., of previous crop) in the surface soil, and by the facilities for drainage afforded by the ridging of the surface soil and consequent exposure of the upper subsoil to the effects of the frost.

In the spring as early as possible the proposed alfalfa field should be prepared for seeding. The preparation should consist of frequent cultivations, harrowings and rollings until the seed bed is perfectly smooth and mellow.

SOWING THE BED.

Alfalfa may be started successfully with a nurse crop. Where preferred it may be sown alone. In either case, a liberal seeding of good germinable seed is necessary. Before purchase a sample of the seed should be secured and tested for germination. It should show over 90 strong germinable seed to the 100. Such seed should be sown at the rate of 25 lb. to the acre. Seed showing a less percentage of germination must be sown more thickly.

Particularly strong heavy soil may be expected to give somewhat better results when a nurse crop is used. Oats, wheat or barley may be used for this purpose. It is probably better to sow somewhat less than the regular amount of grain to the acre, of the sort chosen when sowing as a nurse crop. Some growers advise about half a bushel of seed of the nurse crop to the acre no matter what kind is used, but, with climatic conditions such as maintain in Ottawa, it would not be advisable to sow such small quantities. The drier the climate the smaller the amount of seed of the nurse crop it is advisable to sow. It would seem wise to sow the usual amount of seed per acre of the nurse crop selected (oats 2½ bus., wheat 1½ bus., and barley 1¾ bus. per acre) for the Maritime Provinces, Quebec and Eastern Ontario; about half the regular seeding in Central and Western Ontario; no nurse crop in Manitoba nor in the North-west Territories; and in British Columbia more or less than half a seeding according to the particular district.

With light soils it is usually better to use no nurse crop, but the state of fertility of the particular field should always be considered. A light soil rich in plant food and humus would indicate strongly the use of a nurse crop.

The seed should be sown only after the field is in a state of almost perfect tilth. No cultivation, or at most very little, should be given after the seeding is done. The seed may be sown either broadcast or in drills. Sowing the seed from the grass seed spouts of the average seeder is probably the best method. The spouts should be pointing backwards rather than forward. The ground should be rolled shortly after seeding, and the surface lightly scratched with a brush harrow, a breed weeder or a tilting harrow fairly well tilted back. This latter operation is to prevent evaporation and is necessary only in dry times or in localities having small rainfall.

Any person sufficiently interested to try a small plot should prepare the seed bed thoroughly as indicated above, then sow in rows from 7 to 9 inches or further apart. Another method which we have found very successful is to sow shallow in rows about 15 inches apart and cultivate between the rows. The treatment prescribed for the first season 'without nurse crop' should otherwise be the same as for larger areas.

TREATMENT DURING FIRST SEASON.

The first summer is a critical time in the life of the alfalfa plant.

Without Nurse Crop.—Young alfalfa plants are very tender and must be given no rough treatment before they are well established, but the field must be mown and mown often during the first year to insure success. Blooms should never be allowed to appear. The crop should be cut as often as it reaches 8 to 10 inches in height. Frequent cuttings keep down weeds, aid root development and encourage growth. The clippings should, in almost every case, be left on the field as mulch. As wide cutting a mower as possible should be used and the sickle bars should be tilted to avoid cutting too close.

With Nurse Crop.—During the growing period of the nurse crop no attention is necessary. As harvest time draws on, however, careful watch must be kept to see that the young alfalfa plants are not being smothered by lodging grain. If success with alfalfa is the chief aim, no crop should be allowed to lie lodged upon it for more than a day or two. When harvesting the nurse crop the binder should be set to cut 5 or 6 inches from the ground. Shocks should not be allowed to stand for more than 2 days on the same spot, they would smother out the young alfalfa.

It is not advisable to allow live stock of any kind to graze upon an alfalfa field the first season, but it is not advisable to leave a very high growth to be crushed down by the winter snow. The best plan is to cut at a height of about 5 inches from the ground in September and then leave untouched for the rest of the season.

FEEDING VALUE.

As a feed for stock alfalfa may be used in several ways.

Pasture.—It is frequently used as pasture, and judging by our experiments here has no equal among forage plants for palatability, grazing capacity per acre, and food value. All classes of live stock soon learn to like it and thrive upon it. As a pasture for dairy cows it cannot be surpassed. Sheep thrive upon it exceedingly. Swine are very fond of it and do well upon it as a sole feed. Horses eat it with avidity and improve in condition upon such pasture. In a trial here with dairy cows it seemed to be worth much more than any of the grasses or clovers tested at the same time (red clover, alsike clover, timothy, brome grass and orchard grass).

It should not, however, be pastured too closely at any time. Such treatment would be particularly dangerous the second season. Sheep allowed to crop it closely do very great injury. Another disadvantage is that the trampling of the stock hardens the soil and slowly but surely kills out the catch.

Precautions must be taken too, where it is grazed, to prevent injury to the animals grazing. Cattle and sheep sometimes bloat when allowed to eat it wet with rain or dew. Such stock should be turned in only when the alfalfa is dry or when they have just had a feed of some other forage. Bloating occurs very seldom, but it occurs occasionally, and it is well to avoid any possibility of loss in this way. Hogs and horses are not subject to bloat.

As Ensilage.—Mixed with corn or red clover it is exceedingly valuable for making into ensilage. We have never tried it as an ensilage plant by itself. It has been so used, however, elsewhere and has given good results. In districts where wet weather usually prevails in June the conversion of the first cutting into ensilage would be the most practical way of saving the crop in palatable and nutritious form.

As Soiling Crop.—It is as a soiling crop for dairy cattle that alfalfa is particularly valuable. It makes a very rapid early spring growth and is usually ready to cut before any other green feed. It may be cut for this purpose before any blossoms appear, and will thus admit of being cut about four times in the season in this district. No other soiling crop approaches it in value as a feed for milk production.

It may also be used as a soiling crop for pigs. Where so used it may be expected to reduce the cost of producing pork by from 25 to 50 per cent. in comparison with pigs fed on grain alone.

To give the best results when used for this purpose it should be cut before any blossoms appear, even earlier than when cut to feed to cows. Feed all the pigs will eat up clean. It should be fed both morning and evening.

To summarize, alfalfa used as a soiling crop may be expected to produce from 15 to 24 tons per acre of the finest kind of green forage, most palatable, very nutritious and suitable for horses, cattle, sheep and swine.

As Hay.—It is as a hay crop that alfalfa has won fame and place in British Columbia and the United States, and it is undoubtedly possible of extensive use for that purpose wherever it can be successfully grown in Canada. Under favourable soil and weather conditions it may be expected to produce from five to six tons of hay to the acre per annum.

Alfalfa hay, well made, has no equal as a dry feed for live stock, but no other kind of hay requires as much care, skill and experience or information in the making as does alfalfa.

As the plant begins to blossom its stems begin to turn woody. Plants far advanced in the blossoming stage have very woody stems, easily lose their leaves and then make unpalatable, indigestible and generally inferior, hay.

It is evident, therefore, that to secure good results the crop should be cut at an early stage. Experience has shown the beginning of the blossoming stage to be the best time. The very best time is when about 10 per cent. of the blossoms are in bloom. It is then in its best feeding condition and will come along most rapidly for the next cutting. If the cutting be delayed not only will the hay cured be of an inferior quality, but recovery will be slow and incomplete, entailing a smaller total yield for the year than would otherwise have been produced.

THE MAKING OF THE HAY.

No more than can be conveniently handled in one day should be cut at one time. It is best to cut in the morning as soon as free from dew. Leave in the swath, or preferably shake up with the tedder at intervals till late afternoon or until the hay is well wilted, but not dry enough to lose its leaves, then rake into windrows. If rain threatens put into cock for the night and open out in the morning to finish curing. It should be cured until it will keep without heating, but not made so dry as to cause the leaves to drop off. In the curing and housing it should be handled as little as possible, as each handling means the loss of a considerable number of leaves, and the leaves are, by very much, the more valuable part of the crop.

Alfalfa hay should, if at all possible, be made without getting wet with rain. After being exposed to rain in the curing it is not worth nearly so much as for feed, losing probably half its value. The rain not only causes many more leaves to fall off, but seems to remove much of the palatability digestibility and food elements of the remaining leaves and stems.

It should be well protected when cured, as it absorbs rather than sheds rain. If stored in stacks, a thatch, a canvas, or a lapping board roof should be put on.

ITS FERTILIZING NEEDS.

Just as when sown to clovers and other legumes, both the physical condition and the average plant food content of a soil are improved and increased rather than injured or depleted by being under alfalfa for a time. Certain amounts of the chief elements of plant food are, however, removed by each crop and the application of farmyard manure in the fall at the rate of, say, 10 tons per acre every two years will prove profitable. If it is desired to supplement an insufficient supply of barnyard manure, the following dressing of commercial fertilizer per acre will most likely be found valuable: 30 lb. nitrate of soda, 300 lb. bone meal, and 80 lb. muriate of potash.

ITS FERTILIZER VALUE.

It is as a soil renovator or improver that alfalfa growing is frequently advocated. As mentioned above, however, soil in fairly good heart is necessary to get the crop started. But once started there is no doubt that it has great value as a factor in the improvement of the physical condition and in increasing the fertility of the field where grown. The roots are valuable not only on account of the plant food they supply when decomposing in the soil, but because they open up the subsoil and render it more permeable to surface water, so improving the soil very materially. Undoubtedly the long roots bring up from depths not reached by the roots of other plants much of the food required by the plant; hence the importance of such roots and the great value to agriculture of the plant that is able to produce them.

SUMMARY.

1. Sow sufficient seed.

2. Sow good seed, that is germinable seed.

3. Sow on well-prepared land in good state of fertility.

4. Sowing without nurse crop overcomes in some measure poverty of soil.

5. Proper preparation of the right kind of seed bed and careful observance of directions for first year treatment are necessary to ensure a long series of remunerative crops.

6. Before sowing be sure that a sufficiency of plant food exists in the surface soil to grow a good crop (40 bushels to the acre) of oats.

7. Do not sow on poorly drained land; 'well drained' should mean drained to a depth of at least two feet.—BULLETIN NO. 46, CENTRAL EXPT. FARM, OTTAWA, CANADA.

THE IDEAL COLONY.

EXPERIMENTS IN ENGLAND WITH SMALL DAIRY FARMS.

The colony system, which the Committee regard as essential, has not been adopted to any material extent by county councils under the Small Holdings Act because of the unwillingness of applicants to sever local ties. For a State scheme on the scale suggested it is, however, necessary, if expert guidance, business organization, and the social life to which the men have become accustomed are to be provided. The Committee consider that the ideal settlement would be a village community of at least 100 families all interested in the cultivation and development of the land, but including those engaged in trades subsidiary to agriculture. In some cases the settlement may be established in close proximity to an existing village, and then the whole 100 need not be ex-Service men. In other cases it may be necessary to form a new community, and such a settlement should be designed to accommodate not less than 100 families. The minimum acreage to be taken for a fruit and market garden settlement should be 1,000 acres, and for settlement on dairying or mixed holdings, 2,000 acres.

These minima are selected because of the difficulty of getting more, but whenever enough suitable land is available in the immediate neighbourhood it will be better economy for the State to take a larger acreage. Larger areas will reduce the cost of management, and will be an advantage from the point of view of collective marketing.

The type of holding recommended for men with no previous experience of agriculture is that devoted to fruit and market garden crops. On these they can be trained more quickly and easily than in any other form of cultivation, while the initial planting could be undertaken by State and the cost included in the rent, so that the man would not have to have much capital for stocking the holding. If a holding of three acres is cultivated intensively it is as much as one man can manage without employing hired labour.

The Committee would also like to see an increase in the number of small grass holdings, which in many parts of the country are the most successful type of small holding. They suggest that some of the land at one of the first colonies should be used for a demonstration of arable dairying on holdings of 25 acres. Small mixed farms of from 35 to 50 acres, comprising both arable and grass land, with an addition to the ordinary farm crops a portion devoted to keeping a cow or two, pigs and poultry, and the growth of some fruit and vegetables, while regarded as worth encouraging, are not recommended to men without knowledge and experience.

MANAGEMENT AND CO-OPERATION.

It is recommended that each colony shall be under the control of a resident director possessing both scientific knowledge and practical experience and that there shall be a practical agricultural or horticultural instructor and occasional instruction in special branches. In each colony there should be a demonstration holding managed by the director. Co-operation in the disposal of produce is recommended, though this should not be compulsory. Facilities for the small holders to obtain the use of the larger farm implements are suggested, and also for the hire of horses and extra labour at special seasons, and for this purpose it is recommended that a certain portion of the colony should be kept in hand as a central farm under the management of the director. The Committee suggest that the War Office should hand over to the Board at the conclusion of the war some of the horses and wagons no longer required for military purposes. The central farm might also find employment at certain seasons for small holders not fully employed on their own holdings.

FINANCE.

It is estimated that the cost of the three pioneer colonies will not be more than £334,020. If the land could be leased and military hutments were available it is estimated that the cost of the three colonies would be less than £100,000. The three colonies would not be likely to provide accommodation for more than 300 families, and provision should be made on a much larger scale.

"We think," the Committee say, "that the sum which should be appropriated for the purpose in the first instance should be £2,000,000, and that this amount should be charged on the Consolidated Fund and should be advanced from time to time in such instalments as may be required by the Board of Agriculture and Fisheries. This sum should be sufficient to provide for at least four or five thousand families, including a proportion of unmarried men; but if the number of suitable applicants fell short of these figures, the expenditure of the whole amount would be unnecessary. If, on the other hand, the above figures are exceeded, such additional sums as may be required should be provided."

Emphasis is laid on the need for immediate preparatory steps if the colonies are to be equipped properly by the end of the war.—The Times.

A GREAT GARDENER.

The passing of Canon Ellacombe, after nearly a century of life, deprives the world of amateur gardeners of a personality as unique as it was remarkable. Succeeding his father as vicar of Bitton, near Bath, in 1851, Ellacombe inherited his love of plants along with the vicarage garden, and before many of the present generation of amateur gardeners had left the nursery Bitton had become the Mecca of people interested in horticulture. That it should have remained so to the present time, through all changes that have taken place in more than 50 years, is a wonderful testimony to the influence of the man and his work.

In the 'sixties, convention ruled the garden with a rod of iron; our fathers were still in the clutches of geometrical formality and hide-bound tradition, the latter usually garbed in broad-cloth and a green apron. The cultivation of hardy plants and alpines as practised nowadays was unknown; the carpet bedder reigned supreme; and amateurs with any intimate knowledge of garden plants and their ways were few and far between. That the whole artificial product of ages should have crumbled to the ground so

completely in a comparatively short time was due in large measure to the untiring efforts of WILLIAM ROBINSON and the school of thought he initiated 40 years ago.

THE RETURN TO NATURE.

No one had more sympathy than ELLACOMBE with the desire to let Nature in at the gate and banish the shams and "artistic" monstrosities with which the "landscape artists" and gardeners of the Victorian era cozened their patrons, and Bitton is a good example of trees, shrubs, and plants, forming a picture as satisfying to the eye as it is to the needs of the practical gardener.

Tucked away in the extreme south-west corner of Gloucestershire, in the trough between the Cotswolds and Mendip hills, Bitton is a typical instance of the old English parsonage, peaceful, homely and picturesque. Externally and in its general aspect there is nothing especially remarkable about the place, but once inside the gate the horticultural pilgrims become aware that here indeed is a paradise for plants.

"The Canon," as he was affectionately known to a host of friends, was more concerned with the well-being of the inhabitants of the vicarage garden than with the æsthetic appearance of the place itself; he was pre-eminently a cultivator, and had the inestimable advantage over modern gardeners that more than half a century of experience and continuity of cultivation under ideal conditions alone can bring. Hence it has come about that, notwithstanding the extraordinary high pitch to which the cultivation of plants has been brought within the last few years, Bitton remains almost unique among inland gardens, while few places similarly situated can compare with it where rare flowering shrubs are concerned.

SOIL AND CLIMATE.

It was ELLACOMBE's habit to ascribe much of his success as a cultivator to the alluvial soil and genial climate of his country, and while these factors, as well as the warm vicarage wall, had much to do with the wonderful growth of plants and shrubs, they would have counted for comparatively little if not reinforced by the knowledge, ripe experience, and sympathy possessed by the Canon. ELLACOMBE realized the limitation of his garden and wisely left the cultivation of Alpine plants to those more favourably situated than he was as regards altitude, for Bitton is but a few yards above sea level; but he was no stay-at-home, and in his regular visits to friends contrived to see nearly all that was worth seeing in the many fine gardens that have sprung into existence during the last 30 years. In the course of his life he shared in all the extraordinary changes that have lifted gardening and the cultivation of plants from the moribund condition in which they were in the 'sixties to the wonderful standard of recent years, and his influence has been all for good.

To a cultured mind ELLACOMBE added the possession of an almost unique library of horticultural and botanical works, none of which had any secrets from him; indeed, one never asked for a reference in vain. Like all true gardeners, ELLACOMBE was generous to a degree, and would have shared his last plant with anyone who coveted it. There are scores of gardens in the three kingdoms where his memory will be kept green for many a day.—THE TIMES.

THE DATE PALM IN EGYPT.

T. W. BROWN.

Date palms may be propagated by means of seed and off-shoots. A very large number of the date trees now existing in this country, especially in the Fayum and Upper Egypt, have been grown from seed which has been sown

to a great extent by chance. The system of raising palms from seed does not appear to have been practised systematically at any time on a large scale, and at the present day this method of propagation is not followed except to some extent in Upper Egypt and Nubia. It is rumoured that a large proportion of the trees which are grown from seed produce fruit of inferior quality.

The market of Upper Egyptian towns during the date season overflow with fruit of the poorest types from seedling types.

Palms raised from seed are known as *Maghal*, *Baladi*, *Shebahi*, *Mantoor*, *Masri*, *Mawa*, *etc.* The trees grown under these names in Egypt are extremely numerous and of the most varied description. Occasionally a seedling tree yields fruit of the best quality, and many of the local varieties which are peculiar to certain districts, not to speak of widespread and better known varieties, have no doubt appeared first in Egypt as seedling trees and not as imported plants from other countries.

When a first class date appears among seedling trees the proprietor often plants its off-shoots in order to reproduce the kind without variation, and after a time it receives a distinguishing name and is established as a recognized variety. Any one who makes a collection of Egyptian dates will still find fruit of a good quality included under the name of *Baladi* or *Maghal*.

The process of selection is going on yearly but slowly without any collaboration of one cultivator with another.

When palms are propagated by means of seed the latter should, if possible, be sown at the beginning of summer. The seedlings should be allowed to stay one year in the seed-bed. They are then transplanted and placed two metres apart in nursery rows where they remain until they are large enough to be planted where the trees are to grow. About half the plants are usually male, but the sex of the trees cannot be determined until they produce flowers. To insure the presence of females of fruit-bearing trees it is customary in the province of Aswan to plant several seedlings in each hole. This is one of the reasons why so many of the palms in that part of the country are standing in groups, all the stems apparently arising from the same base. Each group is called a *borá*. When the seedling palms come into flower most of the male trees are removed. In some districts palm trees are required less for the fruit than for the leaves, and seedling trees then serve the purpose quite well. Male trees and all palms which do not yield fruit produce the largest number of leaves. As will be seen later, a crop of leaves is almost always taken even from fruit-bearing trees, and where this is done in strict moderation it is the most profitable course to pursue. For certain work it is, however, necessary to cut the leaves in a young state from the heart of the tree, and in such a case it is impossible to obtain fruit in addition to the leaves.

PROPAGATION BY MEANS OF OFF-SHOOTS.

Good varieties of dates are propagated by means of the off-shoots produced at the base of the young palms. When the off-shoot is planted it very soon commences to make other off-shoots, even if it has not done this before its removal from the parent tree. Some cultivators leave the off-shoots until the mother plant has attained an age of fifteen to twenty years and then remove all the shoots at the same time.

Others remove the most advanced shoots before that time and leave the smaller ones until later. A tree cannot yield a maximum crop of fruit so long as it has a crop of suckers to support; it is therefore well to remove the latter as soon as they are ready to be planted out. Under normal conditions a healthy tree produces ten to twenty-five off-shoots at its base.

The entire group is known as a *kosha*. When these are taken away no more off-shoots as a rule arise on that tree, although in exceptional cases others may appear higher on the stem. In the garden of ISMACIL SIRRY BEY,

Cairo, there exists a tree with one off-shoot on the trunk at a height of more than eight metres from the ground. It is said that there were originally four young plants at the same point. At Gezíret Abu Rísh el Qibli, near Aswân, there are three trees, each bearing several off-shoots three to six metres from the ground. The off-shoots which arise at the surface of the ground commence rooting before they are severed from the parent stem, but there are often one or two situated higher in the *kosha* which show no signs of giving off roots. These are known as *demmil* or *tacoon* and are usually thrown away as being unfit for planting, although the soil is sometimes heaped around them until roots appear. The tool employed to sever the off-shoots from the mother palm is an iron bar with a flat end which is slightly incurved and about five to six centimetres wide. This is held by one man in the axil between the off-shoot and parent tree and the young plant severed by another man with a few blows of the mallet. In Nubia the off-shoots are usually allowed to grow on the mother tree until the young plants have stem one to one and a half metres long. They are then cut half through, bent to the ground, covered with earth and watered by hand until the young tree has produced roots. The off-shoots of different varieties of date palms vary in character, some being thick and stout, whereas those of other varieties are thin and slender.

Off-shoots are known in Arabic as *neila*, pl. *naaiel: biz*, pl. *bezuz*; also as *shetla* and *khilʿa*.

PLANTING THE OFF-SHOOTS.

Date palms may be planted at almost any season of the year. The time of the high Nile—August and September—is the most popular in all parts of the country, but more especially in the south. The temperature is then comparatively low, the atmosphere moist, and water plentiful. Next to this the spring months of March and April are looked upon as being the most favourable season for planting. The vegetative growth of the trees commences towards the end of April or the beginning of May and the off-shoot should be planted if possible before the natural season of growth begins. The cold months of winter and the very hot months of summer should be avoided if possible. For the greater part, off-shoots are planted in their permanent places as soon as they are taken from the mother palm, although they are sometimes planted two metres apart in nursery rows until they produce roots. The latter is by far the best system to follow. When planted in this way the off-shoots do not cover a large area, and in consequence can be irrigated more easily and more frequently. In this way much smaller off-shoots can be made to grow than when they are planted directly in the field. Large numbers of young plants are lost yearly owing to insufficiency of water when they are first planted. This waste of off-shoots of good varieties is very regrettable in a country where the proportion of trees of inferior kinds is so large. If more care is taken to prevent the death of young plants it will be easy to replace quickly the large numbers of poor seedling dates now existing in the country with better and more valuable kinds. Apart from this consideration, planting the off-shoots in nursery rows has the advantage of economising space for two or more years, and when the palms are finally planted in their permanent quarters the plantation comes into bearing in a much shorter time than is the case where the off-shoots are transferred directly from the mother tree to the field. On sandy land the trees are usually transplanted with naked roots, but where the soil is more compact it is better to remove them with a ball of earth attached to the roots. Young plants which have been treated in this way are known as *bint el gôra* or *mohawwal*. In the province of Aswân, the off-shoots are most generally allowed to grow into fruit bearing trees around the mother tree, and plantations are extended by means of off-shoots which are brought down the river from Saccot. These off-shoots are taken from the parent tree in Saccot in the month of February, when they are at once packed tightly together in

bundles surrounded by sacking, matting, and straw, eighteen to twenty-five suckers being packed in each bundle. When packed in this way they are placed near the edge of the river and kept wet until the month of May or June, after which they are taken by camel to Halfa for shipment to Aswân. They are watered during the voyage down the river, so that when they arrive at Aswân they are mostly well furnished with roots among the decomposing packing material. They are then graded, and those which are rooted are sold for planting directly into the field. The others are sold more cheaply to cultivators who usually plant them in nursery plots for sale during the next or following years. When removed from the nursery to the field they are dug up with a ball of earth attached to the roots.

In the Rosetta and Edku districts the off-shoots are planted on low ground where sweet water may be obtained and where the water table is near the surface of the ground. The plants are surrounded by petroleum tins, barrels, etc., to prevent the sand filling the hole. The off-shoots grow in this situation for five to ten years, even after they have commenced to bear fruit. When the trunk attains a length of two metres or more the tree is removed to high land and planted at a depth where there is sufficient moisture to enable the trees to grow without surface irrigation, the sand being allowed to fill the hole around the trunk. In this case the ground is composed of loose sand, so that the trees must be removed with naked roots.

In addition to the system of planting the off-shoots in nursery plots more artificial means are being employed in the United States to encourage the rapid development of roots on off-shoots. This is done by planting them in beds of soil with hot water pipes below. By this means plants can be caused to grow which would be too small to root in the open ground. Proprietors who possess exceptionally good varieties of dates and who wish to propagate them quickly might adopt a modification of the American system by planting the small off-shoots on beds of soil with hot stable manure below.

For planting directly in the field the off-shoots should not weigh less than three kilogrammes when properly dressed and without any external moisture. A good shoot weighs nine to twelve kilogrammes. It is more profitable to plant more moderately large off-shoots, even though they are more expensive, than to plant smaller ones, many of which die. It is specially necessary to use good sized shoots on land composed of loose sand. The larger the shoot the more deeply may it be planted, and the more deeply it is planted the less danger there is of it being moved by the wind.

To avoid the latter evil, cultivators often set the plants in a position sloping towards the north whence comes the prevailing wind. In this position the young plants do not present such a wide surface to the resistance of the wind and are less liable to injury. When growth commences, the plant soon assumes a vertical position. A shoot which is not planted well in the ground is liable to suffer from drought during the first year of its life. This of course is an important consideration where the land is sandy. On the other hand a shoot must not be planted sufficiently deeply to allow water to enter the heart and give rise to decay before growth has commenced. This often takes place in the case of trees which are planted on black land. Here, it is especially necessary to guard against planting too deeply. It is also a good precaution to put some sand in the hole around the base of the off-shoots. In low places which are subject to inundation during high Nile either very large off-shoots or trees which have been rooted in the nursery must be used. In the choice of off-shoots cultivators give preference to those which are taken from trees growing under dry conditions. Shoots of palms growing on high or dry situations root more freely than those from palms on well irrigated land. When the off-shoots are removed from the parent tree, the leaves are cut off, and as soon as the shoots are planted they are wrapped in canvas, dry weeds, or straw, to preserve the growing point from the drying effect of the sun.

DISTANCE APART.

The distance at which trees are planted apart varies between one to three qassabas (3·55 to 10·60 metres). Doubt is often expressed as to whether it is better to plant them widely apart or moderately close together. A consideration of the enormous crops which date palms are capable of yielding when growing under good conditions point to the fact that it is better to concentrate expenditure on a moderate number of trees rather than upon a larger number in the same area. The largest yield of fruit not only per tree but also per feddân is obtained in this way. The lateral roots of an adult palm are sometimes found more than seven metres from the stem and at a distance of five metres the ground is usually full of roots. It is therefore reasonable to allow the tree a space of five metres on each side for the spread of its roots without intermingling with those of its neighbours. Just as a date tree can live and grow under the most varied conditions, so its yield of fruit varies exactly according to the treatment which it receives in regard to space, manure, and water. It may grow and give no fruit whatever or it may yield a crop of 1,000 lb. or more. After a careful comparison of palms growing in different situations and at different distances apart I am of opinion that it is most profitable to plant them at a distance of not less than three qassabas one from the other.

WATERING OFF-SHOOTS.

When the off-shoots are planted in the field it is most important that the soil should be kept constantly moist. The success of an off-shoot which has been properly planted depends entirely upon this point. It is unwise to economise in the watering of newly planted shoots, as any saving of expense effected at this time will lead to increased expenditure and loss of time in replacing dead plants, not to speak of additional irrigation later when it may otherwise be decreased in frequency. On very sandy land in summer the off-shoots may require water daily, although a watering once in two to five days may suffice on better land. On loamy land which does not dry quickly there is a danger of over-watering the plants and causing them to decay before growth commences.

Less water is naturally required in winter when the ground dries more slowly than in summer. During the second year of their life in the field the trees also require less watering than during the first year.—THE AGRIC. JOUR. OF EGYPT.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Soccotrine cwt.	Fair to fine	70/ a 80/
Zanzibar & Hepatic ,,	Common to good	40/ a 75/
ARROWROOT (Natal) lb.	Fair to fine	3½d a 4d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£6 15/ a £7/
East Indian, bleached ,,	Fair to good	£8 15/a £8 17/6
,, unbleached ,,	Dark to good genuine	£6 a £6 10/
Madagascar ,,	Dark to good palish	£6 10/ a £7
CAMPHOR, Japan lb.	Refined	1/8½ a 2/
China cwt.	Fair average quality	155/ nom.
CARDAMOMS, Tuticorin	Good to fine bold	3/6 a 4/6
per lb.	Middling lean	2/ a 2/9
Malabar, Tellicherry ,,	Good to fine bold	3/6 a 4/6
Calicut ,,	Brownish	2/ a 3/
Mangalore ,,	Med Brown to good bold	3/ a 5/3
Ceylon, Mysore ,,	Small fair to fine plump	1/9 a 6/1
Malabar ,,	Fair to good	1/8 a 1/9
Seeds, E. I. & Ceylon ,,	Fair to good	1/9 a 1/10
Ceylon "Long Wild" ,,	Shelly to good	1/ a 1/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	110/ a 120/
Japan ,,	Fair bright small	100/ a 110/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜ d a 7d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾d a 4¼d
	Renewed	3d a 5¼d
	Root	1⅝d a 4d
CINNAMON, Ceylon 1sts.	Fair to fine quill	1/ a 1/9
per lb. 2nds.	,, ,,	11½d a1/6
3rds.	,, ,,	10½d a 1/4
4ths.	,, ,,	9⅝d a 1/1
Chips.	Fair to fine bold	2¾d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	11d a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	7½d a 7⅝d
Madagascar ,,	Fair	7½d
Stems ,,	Fair	2½d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	,,
COCOA, Ceylon Plant. ,,	Special Marks	87/ a 90/
	Red to good	80/ a 85/
Native Estate ,,	Ordinary to red	50/ a 79/
Java and Celebes ,,	Small to good red	70s a 94s
COLOMBO ROOT ,,	Middling to good	15/ a 20/
CROTON SEEDS, sifted,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	150/ a 170/
GINGER, Bengal, rough ,,	Fair	23/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	50/ a 70/
Cochin, Rough ,,	Common to fine bold	37/6
	Small and D's	35/
Japan ,,	Unsplit	30/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	50/s a 80s
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10/
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	45/ a 55/ nom.
Turkey sorts ,,	... ...	65/ a 72/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£7 a £9
	com. stony to good block	60s a £6
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	50/ a 60/
Somali ,,	,, ,,	40s a 50s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	31s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	17s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	3/4½
Ceylon, Straits, ,,	Crepe ordinary to fine	3/5¾
Malay Straits, etc. ,,	Fine Block	2/4¼
	Scrap fair to fine	2/8
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	2/3
Rangoon ,,	,, ,, ,,	2/2

	QUALITY.	Quotations.
INDIA RUBBER lb.		
Borneo ,,	Common to good	2/
Java ,,	Good to fine red	2/3
Penang ,,	Low white to prime red	1/11 a 2/
Mozambique ,,	Fair to fine red ball	2/11
,,	Sausage, fair to good	2/10
Nyassaland ,,	Fair to fine ball	2/9
Madagascar ,,	Fr. to fine pinky & white	2/2
,,	Majunga & blk coated	1/11
,,	Niggers, low to good	1/3 a 1/9
New Guinea ,,	Ordinary to fine ball	2/3 a 2/6
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	14/6 a 15/
,,	Consuming mid. to gd.	13/6 a 14/
	Ordinary to middling	12/6 a 13/6
,,	Mid. to good Kurpah	7s 6d a 9s
,,	Low to ordinary	5/6 a 7/
,,	Mid. to fine Madras	4/6 a 6/
MACE, Bombay & Penang	Pale reddish to fine	2/2
per lb.	Ordinary to fair	2/ a 2/1
Java	,, ,, good pale	2/ a 2/2
Bombay	Wild	5d
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	1/4 a 1/6
	80's	1/
	110's	10d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20
NUX VOMICA, Cochin	Ordinary to good	22/ a 24/
per cwt. Bengal	,, ,,	21/ a 22/
Madras	,, ,,	22/ a 23/
OIL OF ANISEED lb.	Fair merchantable	3/3½
CASSIA ,,	According to analysis	3/11 a 4/1
LEMONGRASS oz.	Good flavour & colour	1⅛d
NUTMEG ,,	Dingy to white	1½d a 1⅞d
CINNAMON ,,	Ordinary to fair sweet	4½d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/8
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	8d
Ceylon ,, ,,	Fair to fine bold heavy	7d
Singapore ...	Fair	7½d
Acheen & W. C. Penang	Dull to fine	nom.
(White) Singapore ,,	Fair to fine	9⅜d
Siam ,,	Fair	9½d
Penang ,,	Fair	9d
Muntok ,,	Fair	10d
RHUBARB, Shenzi ,,	Ordinary to good	2/10 a 4/
Canton ,,	Ordinary to good	1/4 a 2/3
High Dried,,	Fair to fine flat	1/1 a 1/3
	Dark to fair round	8d a 8½d
SAGO, PEARL, large—cwt	Fair to fine	24/6 a 25/
medium ...	,, ,,	24/6 a 25/
small ...	,, ,,	22/ a 23/
Flour ...	Good pinky to white	14/6 a 14/9
SEEDLAC cwt.	Ordinary to gd. soluble	55/ a 90/
SENNA, Tinnevelly lb.	Good to fine bold green	10½d a 11½d
	Fair greenish	8d a 9d
	Common specky & small	5½d a 7⅜d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	50/ a £5 10/
Bombay ,,	,, ,,	60/ a £5 10/
Mergui ,,	Chicken to bold	£6 10/ a £12
Manilla ,,	Fair to good	£6 10/ a 10 10
Banda ,,	Sorts	30/
Green Snail ,,	Small to large	55/ a 75/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	23/ a 24/
per cwt. Madras	Inferior to good	Nominal.
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	10/ a 25/
	Pickings	5/ a 15/
TURMERIC, Bengal cwt.	Fair	25/
Madras ,,	Finger fair to fine bold	37/6 a 40/
Do. ,,	Bulbs ,, ,, [bright	23/
Cochin ,,	Finger fair	30/ a 32/6
	Bulbs ,,	20/
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	7/ a 12/
Madagascar ... } 2nds.	Foxy & reddish 3½a ,,	6/6 a 7/6
Seychelles ... } 3rds.	Lean and inferior	5/6 a 6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares, cwt.	Good white hard	59/

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